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Annual Report

2077/78 (2020/2021)

Government of Nepal

Nepal Agricultural Research Council

National Agricultural Research Institute

NATIONAL SEED SCIENCE TECHNOLOGY RESEARCH CENTRE

Khumaltar, Lalitpur, Nepal

2021

मलीकुलर प्रयोगशालामा डी.एन.ए. परिक्षण

गहुँको चारित्रीकरणको लागि परिक्षण

फापरको चारित्रीकरणको लागि परिक्षण

कोदोको चारित्रीकरणको लागि परिक्षण

धानको चारित्रीकरणको लागि परिक्षण

रामपुर हाईब्रिड-१० मकै को F1 बीउ उत्पादन परिक्षण, देउखुरी

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Cover Page Photo:
Seed laboratory of National Seed Science Technology Research Centre, Khumaltar

FOREWORD

It is my great pleasure to present the annual report 2077/78 of National Seed Science Technology Research Centre (NSSTRC) highlighting the accomplished major activities and their achievements in the fiscal year 2077/78. It is the pioneer seed institution of Nepal started with country's first seed testing laboratory since 1962 at Khumaltar, Lalitpur. It still imparts seed quality testing services to the different seed stakeholders. It is working in collaboration and coordination with seed research and seed producers groups, distributing agencies, quality regulators, policy makers and seed users. It has actively involved in undertaking problems based research on seed quality in a variety of crop species (cereals, horticultural, forage crops etc.) in different aspects viz., seed production, seed morphology, seed physiology, post-harvest handlings, storage and molecular study for diversity analysis. It also provides the technical supports/ services to strength national seed system using the quality seed which is produced within and outside the NARC.

Qualitative and quantitative characterization to develop descriptors and DNA finger printing of different released varieties and pipeline genotypes of cereals, pulses, oil seeds etc. for seed variety identification and maintenance breeding. Hybrid seed production of maize using different female to male ratios, technology generation on quality seed production and seed testing (germination, viability, moisture, purity etc) in laboratory were studied during 2077/78. Source seed production through different commodity programs, DoAR and ARS were monitored to ensure the source seed quality.

I am thankful to all staffs of NSSTRC for their untiring hard works and meticulous efforts to accomplish the field research and laboratory works on time. My special thank goes to Ms. Sangita Kaduwal (S1) and Arjun Prakash Poudel (S1) for compiling and presenting this report in this form. I would like to express my sincere gratitude to the Executive Director of NARC, Dr. Deepak Bhandari, Director of Crops and Horticulture Research Mr. Ram Bahadur KC; former Director of Planning and Coordination, Dr. Ramchandra Adhikari and Director of Finance Dr. Yuga Nath Ghimire for their guidance and continuous support. I hope that, achievements of all activities presented in this report will useful to all researchers, extension workers, planners, policy makers, farmers, developmental partners, academicians, NGOs/INGOs, students and other stakeholders. I look forward to receive constructive comments and suggestion regarding this publication will be highly appreciated.

Narayan Bahadur Dhami
Chief, NSSTRC, NARC,
Khumaltar, Lalitpur

ABBREVIATIONS & ACRONYMS

ABD	Agriculture Botany Division
AFU	Agriculture and Forestry University
AMSL	Above mean sea level
B	Boron
BS	Bikram Sambat
CBO	Community Based Organization
CBSP	Community Based Seed Production
CDD	Crop Development Directorate
CEAPRED	Center for Environmental and Agricultural Policy Research, Extension and Development
Cm	Centimeter
CS	Certified seed
CTAB	Cetyl- Trimethyl-Ammonium bromide
Cu	Cupper
CV	Coefficient of variation
DNA	Deoxyribonucleic acid
DoA	Department of Agriculture
DoLS	Department of Livestock Services
DUS	Distinctness uniformity and stability
EC	Electrical conductivity
Fe	Iron
FS	Foundation seed
FY	Fiscal year
FYM	Farm yard manure
g/gm	gram
Ha	Hectare
HICAST	Himalayan College of Science and Technology
Hrs	Hours
ISTA	International Seed Testing Association
JTA	Junior Techinical Assistant
KU	Kathmandu University
LSD	Least Significant Difference
MAS	Marker Assisted Selection
Max	Maximum
MC	Moisture content
Mg	Milligram
Min	Minimum
mm	millimeter

Mn	Manganese
MoALD	Ministry of Agriculture & Livestock Development
NAGRC	National Agronomy Research Centre
NARC	Nepal Agricultural Research Council
NGO	Non-Government Organization
NGRC	National Genetic Resource Centre
NMRP	National Maize Research Program
NORP	National Oilseed Research Program
NPBGRC	National Plant Breeding and Genetic Research Centre
NR	Nepal Rice
NRRP	National Rice Research Program
NSB	National Seed Board
NSCL	National Seed Company Limited
NSSTRC	National Seed Science Technology Research Centre
NWRP	National Wheat Research Program
PCR	Polymerase Chain Reaction
PIC	Polymorphism Information Content
PICS	Purdue Improved Crop Storage
PMAMP	Prime Minister Agriculture Modernization Project
PPP	Public Privet Partnership
RARS	Regional Agricultural Research Station
RML	Rampur Maize Line
RCBD	Randomized Complete Block Design
SEAN	Seed Entrepreneurs Association Nepal
SQCC	Seed Quality Control Centre
SSR	Simple Sequence Repeat
SSTD	Seed Science & Technology Division
Temp	Temperature
TGW	Thousand Grain Weight
TU	Tribhuwan University
Viz;	Namely
WK	Wheat Khumal
Wt.	Weight
Zn	Zinc
IS	Improved seed
(L.)	Linnaeus
@	At the rate of
^{0}C	Degree Centigrade

संक्षिप्त बार्षिक प्रतिवेदन

यस वार्षिक प्रतिवेदनमा राष्ट्रिय बीउ विज्ञान प्रविधि अनुसन्धान केन्द्रको आ.ब. २०७७/७८ को स्विकृत वार्षिक कार्यक्रम अनुसार उन्मोचन भएका तथा उन्मोचन हुने क्रममा रहेका बालीहरु (धान, गहुँ, कोदो र फापर) को चारित्रिक विवरण तयार गर्ने, धान र मकैको गुणस्तरीय वर्णशंकर बीउ उत्पादन सम्वन्धि प्रविधिको निजी तथा सरकारी निकायको साझेदारीमा कृषकको खेतबारीमा प्रमाणीकरण तथा ठूलो क्षेत्रफलमा प्रर्दशन गर्ने, मकैको मैत्रिक लाईन, धान र गहुँ बालीको जातिय पहिचान र तिनिहरु बीचको जातिय विविधता पहिचानको लागि डि.एन.ए औंठाछाप तयार गर्ने, गुणस्तरिय बीउ उत्पादन सम्वन्धी प्रविधिको विकास गर्ने, विभिन्न सेवाग्राहीद्धारा र अनुसन्धान केन्द्रबाट पठाईएका बीउको नमूनाहरुको परिक्षण सम्वन्धि परियोजनाहरुको कियाकलापहरु संचालन गर्दा प्राप्त प्रतिफलहरु यस प्रतिवेदनमा निम्नानुसार प्रस्तुत गरिएका छन ।

- जिंक र बोरोंन पोलिमर (०.७५ ग्राम बोरेक्स, १.५ ग्राम बोरेक्स, ३ ग्राम बोरेक्स, २ ग्राम जिंकसल्फेट, ४ ग्राम जिंकसल्फेट, ६ ग्राम जिंकसल्फेट, ८ ग्राम जिंकसल्फेट) ले गहुँको बीउ लेपन गर्दा ३ ग्राम बोरेक्सले लेपन गरेको बीउको ५०% उद्भव (Emergence) मा धेरै राम्रो पाईयो भने अन्य सबै चारित्रिक गुणहरुमा फरक पाईएन ।

- मध्य पहाडको मकै-गहुँ बाली प्रणालीमा गहुँको बीउलाई विभिन्न सुक्ष्मतत्वहरु (जिंकसल्फेट, बोरेक्स, मोलीबडेट, फेरस सल्फेटको लेपन र सिफारिश मलखाद प्रयोग गरि लगाइएको परिक्षणमा केवल ५०% फूल फुलेको र ८०% शारिरिक रुपले परिपक्वतामा मात्र भिन्नता पाइयो भने अन्य सबै चारित्रिक गुणहरुमा फरक पाईएन ।

- मध्य पहाडको लागि धान बालीका ७ वटा उत्कृष्ठ जातहरु (एन.आर.१११११५, एन.आर.१११०५, एन.आर.१०६७६, एन.आर.११३७५, एन.आर.११३७४, आइ आर ०८ फ्यान १० र खुमल-४ को जातिय चारित्रिक गुणहरु सम्बन्धि विवरण (Descriptor) पुस्तिका तयार गरियो ।

- मध्य पहाडको लागि गहुँ बालीका १० वटा उत्कृष्ठ जातहरु (डब्लु.के.३१६७, डब्लु.के. २८४३, डब्लु.के.२७८७, डब्लु.के.३००५, डब्लु.के.२८९१, डब्लु.के.३१६६, डब्लु.के.३१६३, डब्लु.के.२८२०, डब्लु.के.३१६५, डब्लु.के.३१६५ र तुलनात्मक जात डब्लु.के.१२०४ र च्याँखुराको जातिय चारित्रिक गुणहरु सम्बन्धि विवरण (Descriptor) पुस्तिका तयार गरियो ।

- कोदो बालीको सिफारिश गरिएका जातहरु (डल्ल कोदो-१, ओख्ले कोदो-१, काब्रे कोदो-१, काब्रे कोदो-२, सैलुङ्ग कोदो १, के.एल.ई-१५९, के.एल.ई-२३६ र के.एल.ई-१५८) जातिय चारित्रिक गुणहरु सम्बन्धि विवरण (Descriptor) पुस्तिका तयार गरियो ।

- फापर बालीका ९ वटा जात/लाईनहरुका सिफारिश गरिएका र पूर्व सिफारिश जातहरुको (एसिसि ३५६७१, एसिसि ३९२५१, मिठे फापर-१, एसिसि ३२१९४, एसिसि ३२२२३-१, एसिसि ३२२१३, एसिसि ३२२७-१, एसिसि ३६५०६, काब्रे बिटर) को जातिय चारित्रिक गुणहरु सम्बन्धि विवरण (Descriptor) पुस्तिका तयार गरियो ।

- तराईको धान-गहुँबाली प्रणालीमा गहुँको बीउलाई विभिन्न सुक्ष्मतत्वहरु (जिंक सल्फेट, बोरेक्स, मोलीबडेट, फेरस सल्फेट को लेपन र सिफारिश मलखाद प्रयोग गरि लगाइएको परिक्षणमा दानाको उत्पादनमा निकै फरक पाइयो भने १००० दानाको तौल र छवालिको उत्पादनमा छुटिने गरि भिन्नता पाइयो भने अन्य सबै चारित्रिक गुणहरुमा फरक पाईएन ।

- मकै बालीको वर्णशंकर बीउ उत्पादन प्रविधिको प्रमाणिकरण गर्नको लागि रामपुर बर्णशंकर-१० को भाले र पोथी २:१, ३:१, ४:१, ५:१, ४:२, ६:२ र ८:२ को अनुपातमा लगाउदा दुई स्थानको परिक्षणको आधारमा १:४ अनुपातको बिउ उत्पादन नै राम्रो भएको पाइयो ।

- रामपुर हाइब्रिड-१०, सिएच१७/१५ र खुमल हाइब्रिड-२ को ठुलो क्षेत्रफलमा प्रदर्शन गर्दा क्रमशः ८२८० कि.ग्रा. प्रति हेक्टर, ७८६० कि.ग्रा. प्रति हेक्टर र ६१२० कि.ग्रा. प्रति हेक्टर उत्पादन दिएको पाइयो र यि मध्ये कृषकहरुले रामपुर हाइब्रिड-१० लाई निकै मन पराएको पाइयो ।

- मकैको इन्ब्रिड लाइनहरु बिचको विविधता पहिचानको लागि २० वटा एस एस आर प्राइमर मार्करको प्रयोग गरि २५ वटा इन्ब्रिड लाइन्हरुको डी.एन.ए. औठा छाप तयार गरियो ।

- धानका ९० वटा रैथाने बासनादार जातहरु बीच जातीय विविधता पत्ता लगाउनको लागि ५० वटा एस.एस.आर. प्राईमर मार्कर प्रयोग गरि डि.एन.ए. औठा छाप तयार गरियो ।

- बीउ परिक्षण सम्वन्धमा सेवा बीउको नमुनाहरु १४८ वटा र अनुसन्धान बीउका नमूनाहरु ९० वटा गरि जम्मा २३८ वटा नमुनाहरुको परिक्षण गरियो ।

EXECUTIVE SUMMARY

This is the annual report of National Seed Science Technology Research Centre (NSSTRC), NARC for the fiscal year 2077/78 (2020/2021). There were five research projects on problems related to quality seed production, varietal identification, maintenance breeding and verification of hybrid seed production technology of maize with PPP model. Experiments were carried out in field as well as in the laboratory of NSSTRC, Khumaltar. Major research areas were; seed production, genuineness of crop varieties and their morphology, DNA finger printing and seed quality enhancement techniques. Crops under study were rice, maize, wheat, finger millet and buckwheat. The key findings of these research studies are as follows:

- In assessment of polymer Zinc and Boron seed coating in wheat, there was a significant difference in days to 50% emergence which coated with different dose of Zinc and Boron polymer.
- In effect of micronutrients seed coating in maize-wheat cropping system in midhills, there was significant difference in traits like days to 50% emergence, days to 50% heading and days to 80% maturity which coated with micronutrients like Zinc sulphate, Borax, Sodium molybdate and Ferrous sulphate.
- Descriptors of seven mid hill rice genotypes namely; NR-11115, NR-11105, NR-10676, NR-11375, NR11374, IR08FAN10 and standard check Khumal-4 prepared.
- Descriptors of ten promising wheat genotypes viz; WK-3167, WK-2843, WK-2787, WK 3005, WK 2891, WK-3166, WK-3163, WK-2820, WK 3165 and WK-3164 and released variety Chyakhura and check WK-1204 prepared.
- Descriptors of five released varieties of fingermillet namely; Dalle-1, Okhle-1, Kabre Kodo-1, Sailung Kodo-1, Kabre Kodo-2 and promising genotypes viz. KLE-159, KLE-236 and KLE-158 prepared.
- Descriptors of eight promising buckwheat genotypes namely; ACC#5671, ACC#9251, ACC#2194, ACC#2223-1, ACC#2213, ACC#227-1, ACC#6506 Kabre bitter and check variety Mithe phapar-1 prepared.
- In effect of micronutrients seed coating in rice-wheat cropping system in terai, NWRP, there was highly significant dufference on grain yield and significant difference in thousand grain weight and biomass yield.
- In verification of hybrid maize seed production technology by using different female and male ratios of 2:1, 3:1, 4:1, 5:1, 4:2, 6:2 and 2:8 were studied. Among these 4:1 ratio found best.

- Rampur hybrid-10, CAH17/15 and Khumal hybrid-2 were demonstrated in large plot, of which Rampur hybrid-10 produced highest grain yield of 8280 kg/ha followed by CAH17/15 (7860 kg/ha) and Khumal hybrid-2 6120 kg/ha). Based on farmers feedback Rampur hybrid-10 was best performing hybrid and farmers demanded large quantity of seed for coming season.
- DNA finger prints of 25 maize inbred lines prepared by using 20 different SSR markers. Similarly DNA finger prints of 95 land races of aromatic rice prepared by using 50 different SSR markers.
- A total of 148 service seed samples and 90 research seed samples were analyzed and reported to the concerned stakeholders.

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1. WORKING CONTEXT

National Seed Science Technology Reseach Centre (NSSTRC) is one of the important disciplines under National Agricultural Research Institute(NARI) of Nepal Agricultural Research Council located at Khumaltar (1335m amsl; 85°10′ E and 27°39′ N). It is featured to lead the research and reviews on the problems relating to seed quality, seed physiology, seed production, seed health, harvest, processing, sampling, pre-and post-harvest management. Seed enhancement technology, variety identification, genetic purity evaluation, testing for genuineness of plant variety, development of seed quality assessment procedures, human resource development, and seed quality testing are therefore the research areas of the centre. It embark on the research works on these disciplines and provides services ensuring the production and supply of quality seed to farmers in a right place and time and helps in achieving a good harvest.

In the present context of depleting land and increasing population, we have to produce adequate food to address the hungry mouths. It is the established fact that use of quality seed maintains required plant population and uniform maturity leading to improving yield by 15-20 percent. Basic and applied researches on seed science and technologies relating to seed quality, seed biology, seed management, seed quality enhancement, pre-harvest and post- harvest management, and seed distribution and support in activities related to seed policies and regulations are the areas dealt during the year as core research activities. Consequently it works in collaboration with different institutions/programs with seed component and involved in improving information about use and supply of quality seeds in the country. Major collaborative institutions are Seed Quality Control Centre (SQCC), Department of Agriculture (DoA), Crop Directorate of Development and Agriculture Biodiversity Conservation Center, National Seed Company Limited (NSCL), SEAN, CEAPRED, private seed companies, universities, seed cooperatives, CBSP groups and farmers.

2. INTRODUCTION

2.1 Introduction and Background

Seed Science and Technology Research Unit was established as first seed testing laboratory in 1962 in Agronomy Division under the Department of Agricultural Development (DoAD). It got accredited to the International seed Testing Association (ISTA) in 1964. In early seventies, seed testing laboratory moved to Agriculture Botany Division (ABD) to work in close with the breeders. Seed Technology and Improvement Program (STIP), Central Seed Science and Technology Division (CSSTD) were the upgraded modalities and given the divisional status for bridging between research, extensions and end users of seed through seed certification, field inspection, seed testing, seed technology research and planning and monitoring of source seed production. On inception of Nepal Agricultural research Council (NARC), Seed Research as a Unit merged again in ABD and is entitled to conduct seed research on practical problems and support in strengthening national seed system in use and distribution of quality seed.

Seed Science and Technology Division (SSTD) as an independent division under NARI had approved by the 41st NARC Council meeting. It had been effective as central division of seed in Khumaltar from 2010/11 fiscal year. Later on in fiscal year 2019/20, 59th NARC Council meeting changed its name as "National Seed Science Technology Research Centre (NSSTRC)" with mandates. It acts as focal center for seed components in NARC assisting the use and production of quality seed through research for agricultural development and work on seed in close association and coordination with stakeholders of seeds under National Seed Board (NSB).

2.2 Objectives

- To carry out the seed technology research on problems associated with quality seed on seed production, harvesting, post-harvest handlings, storage, seed morphology and seed physiology based on seed quality testing protocols.
- To develop and standardize seed testing techniques through research supporting the seed certification system.
- To establish and coordinate the source seed production in NARC farm/stations and its distribution.
- To provide seed testing services to seed producers, seed companies, I/N/GOs with seed component, research entities, farmers etc.
- To work in close collaboration with the different stakeholders (central and provincial) of national and provincial level on seed problems in coordination with seed quality control centre, central seed testing laboratory and provincial seed testing laboratory.

2.3 Mandate

- Promote and prioritize seed sector research and development.
- Develop road map, directives and monitor of seed science related programme at national level.
- Monitoring and evaluation of source seed production and seed quality under NARC stations.
- Preparation of seed science related programme and policies to support national seed system.
- Conduct research on seed quality, seed testing and provide DNA finger printing service.
- Capacity building of manpower involved in seed sector research and development.
- Coordinate, liaise and collaborate with national and international organizations under the directives of NARC.

2.4 Thematic thrust areas for research

Seed is the most essential and viable input in agriculture. Quality seed leads to increase in production and productivity by 15 to 20%. Its quality is affected by biotic and abiotic factors at various stages during production, harvesting, post-harvest handlings and storage. Based on agricultural research priorities and practical problems demanded by time, space (location specific) and clients, following basic and adaptive research areas on seed technology with practical implication have been identified.

2.4.1 Seed Production Technology

Seed production follows a definite sequence of steps and needs constant surveillances and immediate actions. Introduction of new varieties like hybrid, inbred, forage varieties; diverse cropping systems, cultivation of a range of crop species with different biology, climate change and incidence of diseases/pests and their threats are major factors that may create problems in seed production. Seed crop physiology, crop husbandry, the biology of seed maturation, role of minerals and micronutrients are the important aspects in seed production which requires intensive research for harvest of quality seed. Following points should be considered to adopt the quality seed production:

- Appropriate site selection
- Suitable varieties/genotypes
- Optimum isolation distance
- Optimum fertilizer dose
- Regular monitoring and field inspection
- Rouging
- Harvesting

- Processing
- Seed certification / Truthful labeling
- Storage

2.4.2 Seed Testing Technology and Seed Physiology

Seed testing for moisture%, germination% and purity% is carried following the methods standardize by ISTA. Testing determines the planting value of seed. Timely filed inspection and lab testing procedures are required for seed certification and truthful labeling. However, discrepancies in test results do occur in seed testing. In these circumstances, the center undertakes research to develop the appropriate testing technology in availing the assessment of quality seed and supports to develop the seed standards.

2.4.3 Seed Morphology and Taxonomy

Genetic purity is one of the quality attributes of seed. It is maintained through isolation, field inspection and physical purity and pre and post-harvest control plot tests at laboratory. It is necessary to undertake the practical researches and develop the distinguishing and identifying characters of each named varieties to avoid the genetic contamination in the standing up field and seed. The center, therefore undertakes the genuineness cultivar testing through agro-morphological characterization, biochemical and molecular testing.

2.4.4 Seed Post Harvest, Handling and Storage Technology

Seed is a living material which deteriorates time over and finally dies. Seed processing, drying, seed moisture%, seed treatment, seed storage containers, storage condition and mechanism of seed dissemination have great effect on seed viability and longevity. The center facilitates in carrying research on these areas and it has also an experience of working in collaboration with the national and international seed technology institutions.

2.4.5 Seed Variety Identification Using DNA Finger Printing Technology

DNA finger printing is a new advancement tool in molecular techniques and its application helps breeders and seed analysts in crop research, conservation of biodiversity and seed varietal identification. The centre is providing DNA finger printing using SSR marker in cereals, legumes and vegetable crops for variety release and registration process.

2.4.6 General Seed Testing

Following quality testing services are provided to seed producers, groups, seed companies and researchers etc.

- Moisture test

- Physical purity test
- Germination test
- 1000 grain weight test
- Proficiency seed sample test.

2.4.7 Special Seed Testing

Special seed testing services are provided in the laboratory. For special seed testing following testing services are provided.

- Tetrazolium salt test
- Vigor test
- Viable test
- Cold testing
- Ageing test
- Biochemical test
- DNA fingerprinting

2.5 Major Activities

- Biochemical test for varietal identification of vegetable species for genuineness of cultivars.
- Descriptors of pre-release varieties were developed based on agro-morphological traits.
- Establishment of seed production technology as per seed production environment.
- DNA fingerprinting using SSR marker for identifying genetic diversity among promising genotypes of different crops.

2.6 Major Achievements

- DNA fingerprinting of *Garima* variety of rice was done and documented.
- Suitable hermetic storage structures (Super grain bag, PICS bag and Safe grain bag) identified for grain storage.
- Zeolite beads identified as suitable drying storage tool for vegetables and high value crops.
- Seed germination percentage and viability increased if maize seed and roasted wheat is kept in ratio is 5-6:1 in air tight container or plastic bag.
- Seed pre-treatment techniques for rice, finger millet, *Sesbania* etc. established to break the seed dormancy/hard seed.
- Genetic and physiology of seed dormancy in improved rice varieties identified using SSR markers.

2.7 Infrastructure and facilities

The centre has its own two floor office building but top floor is using by National Biotechnology Research Centre, Khumaltar, Lalitpur (Annex 3). This centre has seed testing/research laboratory, molecular laboratory and field for other research. It is equipped with the seed quality testing facilities and molecular marker testing at DNA level. It provides seed testing services of all kinds of agricultural, horticultural and forage crop species to farmers, seed producers, seed companies, researchers and provides analyzed reports following the rules for testing seeds by ISTA, 2011 and guidelines and norms developed by national seed regulatory body under NSB. Analytical purity test, moisture test, germination test are the general testing services whereas accelerated ageing test of wheat, cold test of maize, tetrazolium test, biochemical test for varietal identification (phenol and potassium iodide-iodine tests) and pre and post field plot tests are the special tests providing by the centre. The centre has strengthened the molecular testing facilities for carrying out the genuineness test of the crop varieties using DNA molecular markers and these facilities are also used in studying the genetic diversity of agricultural crops specific to landrace diversity. These facilities are listed in annex 4.1 and 4.2.

The centre also provides technical backstopping to SQCC in developing seed testing procedures, seed standards, field standards and minimum quality standards and assists in planning of source seed demand and supply. The centre generates database on seed and seed related other matters and coordinate the NARC seed component among the seed stakeholders.

2.8 Organizational structure and human resource

Following figure explains the organizational structure of NSSTRC. It explains the working modality and human resources strength (HRs) that is adopted to help in achieving the objectives and strategies of the centre. The centre has ten staffs namely; one senior scientist (S-3), two scientists (S-1), one technician (T_{-5}), one administrative officer, (A_{-6}), one account officer (A_{-6}), three lower technicians (T_{-1}) and one light driver. Details of human resource is given in Annex 5.

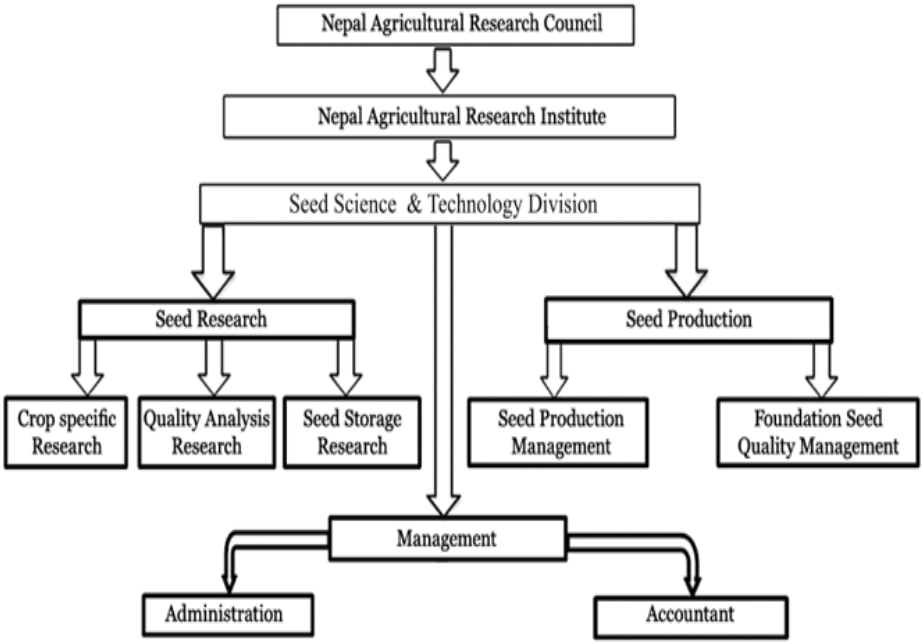


Fig. 1: Organogram of NSSTRC

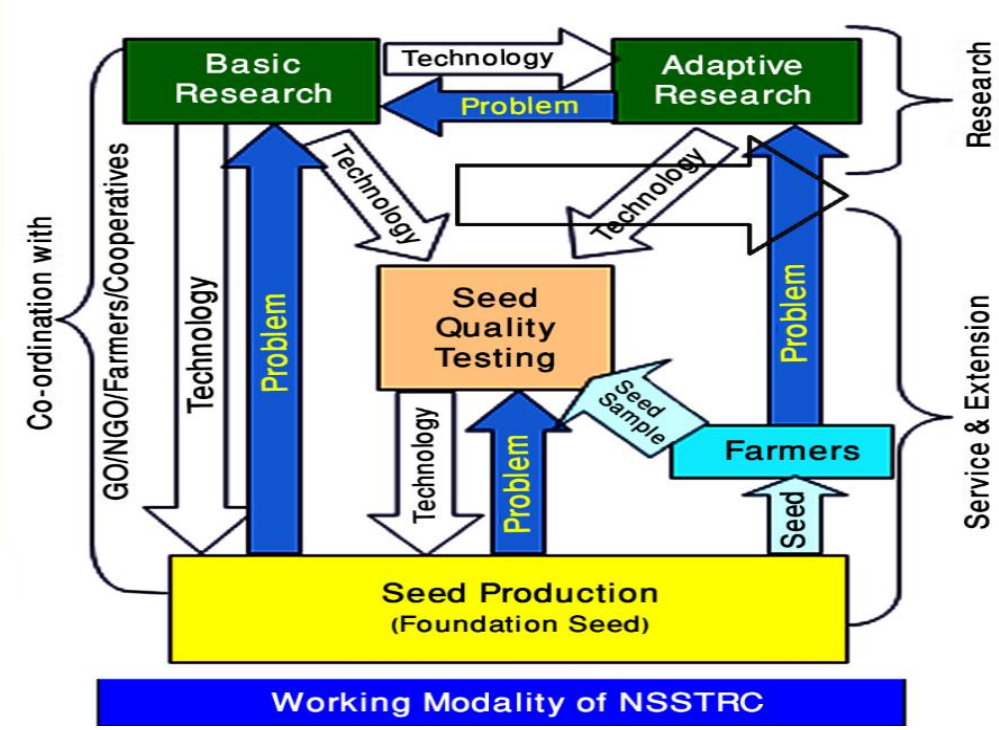


Fig. 2: Working modality, NSSTRC

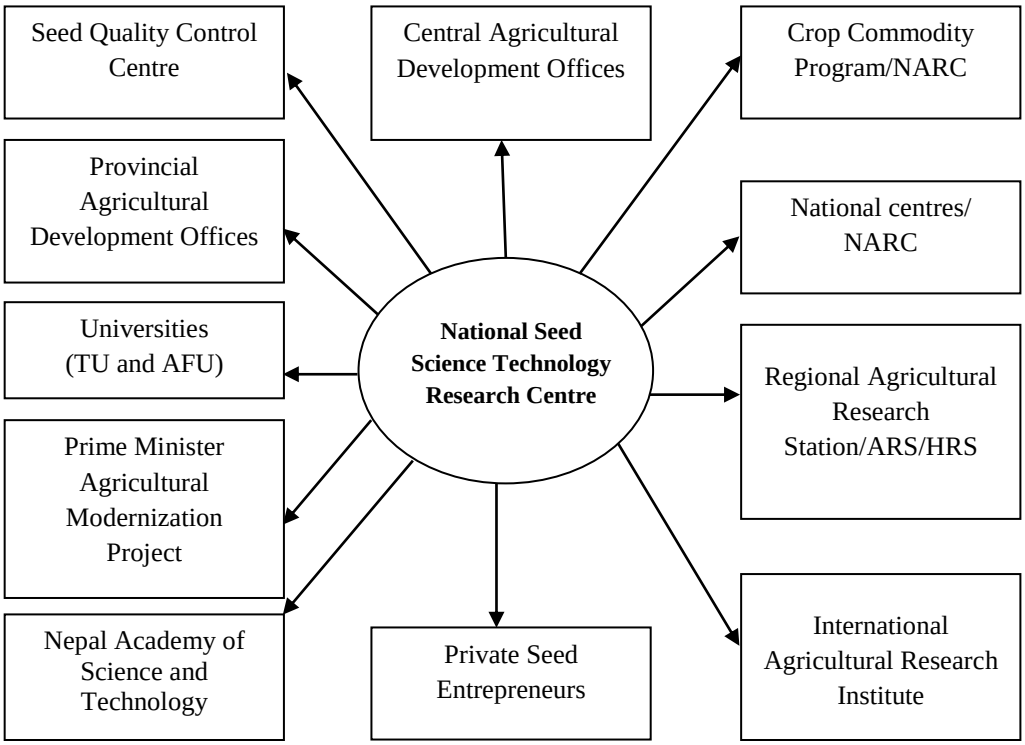


Fig. 3: Linkage and coordination, NSSTRC

3. RESEARCH HIGHLIGHTS

The Summary of progress report of different projects under NSSTRC, Khumaltar, Lalitpur were presented in Annex 6. The details of individual project is explained as below.

3.1 SEED PRODUCTION TECHNOLOGY

Assessment of polymer zinc and boron seed coating in wheat

Introduction:

Wheat (*Triticum aestivum* L.) is third major food crop next to rice and maize in Nepal with production of 1,94,9001mt and productivity of 2.76 t/ha (2019/20). Various problems associated for yield gap, one is micronutrient. Micronutrient deficit (80 to 90% B, 20-50% Zn & 15% Mo) in Nepalese soil is not only limit agricultural production but also affect human nutrition directly or indirectly (Andersan, 2007). Application of B at reproductive stage enhanced seed yield of wheat while its deficiency might cause male sterility resulting in seed set failure. Nutritional insecurity, mineral deficiency in edible grains, is a major health issue for human being in most of the developing countries. Dietary Zn deficiency in humans may result in loss of immunity, poor wound healing and dermatitis. Micronutrients seed coating help immediate and constant source of Zinc, Manganese and Boron etc. enhance to emergence of seed, healthier root and vigorous plant growth and increase yield potential. It also prevents diseases and pests and promote seedling growth and increase yield. Seed coating with Zn increase the Zn contents in grain from 21 to 35 %, while 33-55% improvement in grain yield was recorded. Seed coating is most interesting and benficial treatments for improving seed quality. Micronutrients are chemical elements essential for plant growth and are necessary in small quantities and the absence of any one of them can result in significant reduction in productivity and this problem may be corrected with seed treatment based on the principle that the seed reserves are important source for preventing the development of initial symptoms of deficiency in plants.

Materials and methods:

The experiment was laid out in RCBD with three replications along with eight treatments. It was carried-out in the research field at NSSTRC, Khumaltar during winter season, 2020/2021. Recommended seed rate was 120kg/ha and dose of chemical fertilizer was @120:60:40 Kg NPK ha^{-1}. The plot size was of 2.5m×4m for each treatment. Rows were spaced of 25cm apart and seeding was continuous. WK1204 seeds were coated with micronutrients and shade dried before sowing. The trial consisted of eight different treatments viz:0.75gmborax, @1.5gmborax, 3gm borax, 2 gm zinc sulphate, 4 gm zinc sulphate, 6 gm zinc sulphate, 8 gm zinc sulphate per kg seed and control plot. FYM applied. Half dose of N and full dose of P_2O_5 and K_2O was applied as

a basal dose just before seeding. Seeding was done on 18th, Dec, 2020. The remaining half of N was divided in to two split doses i.e. first half was applied at tillering stage and remaining half at booting stage. Irrigation was managed as per the plant growth stages and moisture level in soil. Five randomly selected tillers/hills tagged with marker to record the data. Data were processed and analyzed by using R stat.

Results and discussion:

There was significant difference found in days to 50% emergence and no significant difference in traits like plant height, no of tillers, no of spikelet per spike, spike length, no of grains per spike, sterility%, days to heading, days to 80% maturity, SPAD reading at different time interval, 1000 grain weight, biomass yield and grain yield. Detail results are presented in table **1.**

Table 1. Effect of wheat seed coating on phenology, yield attributing traits and grain yield, NSSTRC, Khumaltar.

Treatment (No.)	50% DE	PH (cm)	TN/P	NS/S	SL (cm)	GN/S	St%	50% DH	80% DM	Spad 30 DAS	Spad 60 DAS	Spad 90 DAS	Spad 120 DAS	TGW (gm)	BY (tha^{-1})	GY (tha^{-1})
0.75 g Borax	16	94.3	10	17	10.1	49	1.7	114	146	57.0	53.5	60.8	54.9	41.5	9.2	3.70
1.5 g Borax	16	92.9	10	17	11.4	48	1.0	114	146	52.6	55.4	61.3	53.6	40.8	8.7	3.76
3 g Borax	18	92.7	10	16	11.03	47	1.4	114	146	56.4	56.2	58.7	54.0	41.4	8.2	3.70
2 g ZnSo4	16	93.1	10	17	11.1	52	1.1	114	146	53.4	56.3	58.1	53.5	42.7	8.0	3.97
4 g ZnSo4	16	94.6	10	17	11.6	50	1.7	115	147	52.7	53.4	56.6	54.9	40.2	10.3	3.47
6 g ZnSo4	16	97.3	10	16	12.0	48	1.2	114	146	53.9	56.1	55.9	51.3	40.1	10.9	3.82
8 g ZnSo4	16	95.9	10	17	11.5	55	1.2	114	146	52.2	53.9	60.9	51.7	42.6	8.6	4.03
Control	16	90.8	11	16	9.8	44	1.93	114	146	54.4	52.7	59.4	51.8	41.7	7.9	3.61
Mean	16.4	93.9	10.6	17.0	11.0	49.7	14.3	114	146.3	54.1	54.7	58.9	53.2	41.43	8.9	3.22
P-value	**	ns	ns	ns	ns	ns	ns	ns	ns	nns	ns	ns	ns	ns	ns	ns8
LSD (0.05)	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CV %	5.0	2.9	6.8	7.1	12.5	11.5	31.5	0.4	0.3	7.5	6.3	5.3	0.0	11.3	17.7	12.28

Note: DAS=Days After Seeding, DE=Days to 50% Emergence, PH=Plant Height , TN/P=Tiller Number/Plant, SN/S=No of spikelet/spike, SL=Spike length, GN/S= Grain Number/Spike, St%=Sterility %, 50% DH=Days to 50% heading, 80% DM=Days to 80% Maturity,TGW=Thousand Grain Weight, BY=Biomasss Yield, GY=Grain Yield

Effect of micronutrient seed coating in maize-wheat cropping system in mid hills

Introduction:

In Nepal most soil suffer from micronutrients deficiency due to intensive cropping system. Day by day, the micronutrients are reducing in soil due to more dependence on synthetic fertilizers and increase in cropping intensity with high nutrient requiring varieties. Limited use of organic manure, imbalanced use of macronutrient fertilizers, reduced recycling of crop residues etc. have led to micronutrient deficiencies. Increase in fertility levels progressively increases the total removal of micronutrients due to increased dry matter production thus reducing productivity and quality of wheat seed. Rice-maize cropping system is one of the most important cropping system in midhill of Nepal. However, sustainability of this system is under threat owing to several factors, of which deficiency of micronutrients particularly zinc (Zn), boron (B) and manganese (Mn) is one of the major problems. In the cereal-based cropping system, Zn deficiency is a widespread chronic problem in Nepal. Micronutrient deficiency occured due to more CaCO3 contents and less organic matter content. Continuous rotation of rice and maize, imbalanced fertilizer use and little/no use of micronutrient-enriched fertilizers induce deficiencies of Zn, B and Mn. Among various strategies seed coating could be the most effective practice. It is sustainable and cost-effective approach. Through seed coating of micronutrients, its concentration can be increased. Seed coating helps immediate and constant source of micronutrients.

Materials and methods:

The experiment was laid out in RCBD with three replications and consisted of seven treatments viz: T1=Farmer practice (1/2 NPK), T2=RDF NPK, T3=RDF NPK+(ZnSo4 @ 2gm+Borax @ 1gm+Sodium Molybdate @ 0.5gm+Ferrous Sulphate @ 0.5gm)/kg, T4=T3- (ZnSo4 @ 2gm/kg seed), T5=T3- (Borax @ 1gm/kg seed), T6=T3-(Sodium Molybdate @ 0.5g/kg seed, T7=T3- (Ferrous Sulphate @0.5g/kg seed. It was conducted under the research field of NSSTRC, Khumaltar during winter season 2020/2021. Recommended seed rate was 120kg/ha. Seeding was done on 18th, Dec, 2020. The plot size was of 2.5m×4m for each treatment. WK1204 seeds were coated with different micronutrients and shade dried before sowing. Rows were spaced of 25cm apart and seeding was continuous. Recommended dose of chemical fertilizer was applied @120:60:40 Kg NPK ha^{-1}. Half dose of N and full dose of P_2O_5 and K_2O was applied as a basal dose just before seeding. The remaining half of N was divided in to two split doses i.e. first half was applied at tillering stage and remaining half at booting stage.

Irrigation was managed as per the plant growth stages and moisture level in soil. Five randomly selected tillers/hills tagged with marker to record the data. All required data recorded from selected hills except grain yield and biomass yield. Data were processed and analyzed by using R stat.

Results and discussion:

There was significant difference observed in traits like days to 50% emergence and pheneological traits like days to 80% heading and days to 80% maturity. Non significant difference was observed in traits like plant height, number of tiller per palnt, number of spikelet per spike, spike length, number of grains per spike, sterility%, 1000 grain weight, SPAD reading at different time interval, grain yield and biomasss yield. Detail results are given in table 2.

Table 2. Effect of wheat seed coating on phenology, yield attributes and grain yield in maize-wheat cropping system, mid hills, Khumaltar.

Trt. No.	50% DE	PH (cm)	TN	SN	SL (cm)	GN/S	St %	TGW (gm)	50% DH	80% DM	Spad 30 DAS	Spad 60 DAS	Spad 90 DAS	Spad 120 DAS	GY (tha^{-1})	BY (tha^{-1})
T1	16^{ab}	80.3	6	16	10.8	50	9.6	38.3	112^{b}	144^{b}	54.6	54.7	61.7	53.9	4.14	7.3
T2	16^{ab}	80.7	6	17	10.9	47	11.4	39.4	113^{ab}	145^{ab}	52.5	57.5	60.1	54.8	4.28	8.2
T3	16^{ab}	80.3	7	17	10.9	50	11.0	35.4	114^{a}	146^{a}	52.9	56.1	59.0	54.8	4.29	7.9
T4	16^{ab}	82.9	7	17	10.8	53	9.2	43.7	113^{ab}	145^{ab}	54.6	55.6	60.6	54.1	4.13	8.2
T5	16^{ab}	81.3	6	17	10.5	53	10.3	47.3	114^{a}	146^{ab}	53.6	55.9	59.6	55.8	4.58	8.3
T6	18^{a}	76.1	5	17	11.0	48	7.6	39.4	114^{a}	146^{ab}	53.7	54.3	60.2	56.5	4.56	6.9
T7	17^{ab}	83.3	6	17	10.9	50	9.0	38.5	114^{a}	146^{ab}	52.5	55.3	58.3	56.4	4.53	8.1
Mean	16.85	80.7	6.6	17.5	10.8	50.8	9.8	40.3	113.7	145.7	53.5	55.7	59.9	55.2	4.36	7.9
P-val	*	ns	ns	ns	ns	ns	ns	ns	*	*	ns	ns	ns	ns	ns	ns
LSD(0.05)	1.5	-	-	-	-	-	-	-	1.4	1.4	-	-	-	-	-	-
CV%	6.0		25.3	4.9	3.1	9.2	34.6	8.6	0.7	0.6	7.1	3.1	3.9	3.6	9.36	16.3

Note: DE=Days to 50% Emergence, PH=Plant Height , TN=Tiller number, SN=Spikelet number/spike, SL=Spike Length, GN/S=Grain number/spike, St%=Sterility%, DH=Days to 50% Heading, DM=Days to 80% Maturity, TGW=Thousand Grain Weight, BY=Biomasss Yield, GY=Grain Yield, T1=Farmer practice (1/2 NPK), T2=RDF NPK, T3=RDF NPK+(ZnSo4@2gm+Borax@1gm+Sodium Molybdate@0.5gm+Ferrous Sulphate@0.5gm)/kg, T4=T3-(ZnSo4@2gm/kg seed), T5=T3-(Borax@1gm/kg seed), T6=T3-(Sodium Molybdate@0.5g/kg seed, T7=T3-(Ferrous Sulphate@0.5g/kg seed)

3.2 MORPHOLOGY AND TAXONOMY

3.2.1 Agro-morphological characteristics study of hill varieties of rice

Introduction:

Rice (*Oryza sativa L.*) is one of the most important food crop among the cereals in Nepal. It occupied of 14,69,545 ha of land with production of 5151925mt and productivity of 3.50t/ha respectively (MOALD, 2019/2020). Newly developed varieties/genotypes must be distinct, uniform and stable. Varieties are mainly identified with respect to their morpho-physiological attributes. With the introduction of high yielding varieties/genotypes and new technologies becoming a great threat to secure the age-old practice of growing traditional varieties and landraces which may have immense potential for different important traits.Qualitative characters are considered as morphological markers in the identification of landraces of rice because they are less influenced by environmental changes and the most common approach utilized to estimate relationships between genotypes. The rice pure lines which possess exclusive variability and unique features need to conserve and utilization in future rice breeding program to develop new rice varieties for issues like intellectual property rights.

Objective:

- To develop descriptor of promising rice genotypes that helps to respective commodity breeders to maintain genetic purity.
- To support variety release and registration process that helps to seed producers, crop inspectors in the field.

Materials and methods:

Seven promising rice genotypes viz. NR-11115, NR-11105, NR-10676, NR-11375, NR-11374, IR08-FAN10 and standard check variety Khumal-4 received from NPBGRC for agro-morphological characterization during summer season 2020/21. Experiments were conducted under research field, NSSTRC and NPBGRC, Khumaltar. The experiments were laid out in RCBD with three replications. Plot size was 4m*1m with 20cm*20cm crop geometry. Seedlings were raised in dry bed nursery using 50 kg seed ha^{-1}. Seeding was done on 21th May, 2020. Transplanting was done in puddled field on 26th June, 2020. The recommended dose of chemical fertilizer was @ 100:30:30 kg N:P:K ha^{-1} . Half dose of N, K_2o and P_2o_5 was used as basal dose during transplanting. Remaining dose of N was splits in two doses and top dressed at the time of tillering stage and booting stage. Interculture operations were carried out at different crop growth stages as and when required. Data were recorded from the net harvested area (NHA) from each plot. Five hills were selected randomly from NHA of each plot and selected hills tagged with marker for data recording. The qualitative, quantitative and biochemical traits were

recorded according to UPOV guide lines. Additional traits were also studied viz., leaf blade length, leaf blade width, no. of tillers/plant, no. of grains/ plant, sterility %, grain yield t/ha, date of booting, heading, maturity and straw yield.

Results and discussion:

Variation in qualitative traits:

Significant variations were observed in most of the qualitative traits. Leaf colour was light green in NR11115 and green in NR11105, NR10676, NR11374 as compared to check variety Khumal-4 which had dark green foliage colour. Leaf blade pubescence was weak in NR11115, IR08FAN10. Culm habit was semi-erect in NR11115, NR11105, NR10676 while Khumal-4 had erect culm habit. Partial male sterility was observed in NR11375. Lemma anthocyanin colouration of keel, area below apex, anthocyanin colouration at apex was weak in NR11375. Pubescence of lemma was medium in NR11115, NR11105 and NR101676. Color tip of lemma was brownish in NR11375 as compared to check variety Khumal-4 which was yellowish. In type 2 type of panicle; secondary branching was observed in NR11115, NR11105, NR10676, NR11375 and NR11374. Late leaf senescence was observed in I08FAN10. Gold lemma colour was observed in NR11105 and NR11375. Lemma anthocyanin colouration of keel, anthocyanin coloration of area below apex and anthocyanin coloration of apex was weak in NR11375. Detail results are given in table 3.

Table 3: Variation in qualitative traits of promising rice genotypes evaluated in mid-hill environment, Khumaltar

Treatments	**NR11115-B-B-31-3**	**NR11105-B-B-27**	**NR10676-B-5-3**	**NR11375-B-B-21**	**NR11374-B-B-23**	**IR08FAN10**	**Khumal-4**
Leaf: Intensity of green colour	Light green	Green	Green	Dark green	Green	Dark green	Dark green
Leaf blade: Pubescence of surface	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak
Culm: habit	Semi-erect	Semi-erect	Semi-erect	Erect	Erect	Erect	Erect
Male sterility	Absent	Absent	Absent	Partially male sterile	Absent	Absent	Absent
Lemma: Anthocyanin coloration of keel (early observation)	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak
Lemma: Anthocyannin coloration of area below apex	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak
Lemma: Anthocyanin coloration of apex (early observation)	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak
Spikelet: Pubescence of lemma	Medium	Medium	Medium	Strong	Strong	Strong	Strong
Spikelet: Color of tip of lemma	Yellowish	Yellowish	Yellowish	Brown	Yellowish	Yellowish	Yellowsih
Panicle: Type of secondary branching	Type 2	Type 2	Type 2	Type 2	Type 2	Type 3	Type 3
Leaf: time of senescence	Early	Early	Early	Early	Early	Late	Early
Lemma: Colour	Light gold	Gold	Light gold	Gold	Light gold	Light gold	Light gold
Lemma: Anthocyanin coloration of keel (late observation)	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak
Lemma: Anthocyanin coloration of area below apex (late observation)	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak
Lemma: Anthocyanin coloration of apex (late observation)	Absent or v.weak	Absent or v.weak	Absent or v.weak	Weak	Absent or v.weak	Absent or v.weak	Absent or v.weak

Variation in quantitative traits:

The results of ANOVA revealed that, significant variation was observed in most of the quantitative traits where genotype NR11115 with longest leaf blade length (53.93 cm) and shortest leaf blade length (37.70 cm) of IR08FAN10. Maximum tiller number (12) was observed in NR10676 which was at par with IR08FAN10 (12) and minimum (9) in NR11105. Similarly NR11374 had maximum number of grains per panicle and IR08FAN10 had lowest number of grains per panicle (86). Genotype IR08FAN10 had longest grain length (6.93 mm). Early genotype IR08FAN10 in terms of days to 50% heading (102 days) and days to 80% maturity (134 days) and late genotype in terms of 50% heading (115days) and days to 80% maturity (145 days) was NR11115. A significant difference in grain yield was observed where highest yielded (7.49 tha^{-1}) genotype was NR11115. Detail results are given in table 4.

Table 4. Variation in quantitative traits of promising rice genotypes evaluated in mid hill environment, Khumaltar

Genotypes	LBL (cm)	LBW (cm)	GL (mm)	TN /P	PH (cm)	SL cm)	PDL (cm)	PL (cm)	GN /P	St %	TGW (gm)	GL (mm)	GW (mm)	DCGL (mm)	DCGW (mm)	DGS (mm)	DH 50%	DM 80%	SY (tha^{-1})	GY (tha^{-1})
NR11115	53.9^{a}	0.9	2.3	10^{bc}	136.3^{bc}	23.4	5.3^{a}	26.0	150^{a}	30.5	22.0	8.8	2.8	6.3^{b}	2.4	1.7	115^{a}	145^{a}	26.30^{a}	7.49^{a}
NR11105	47.5^{c}	0.9	2.3	9^{c}	145.3^{ab}	23.8	6.5^{a}	24.5	131^{ab}	27.8	18.6	9.0	2.6	6.4^{ab}	2.4	1.8	112^{ab}	142^{ab}	20.95^{b}	7.15^{ab}
NR10676	53.2^{ab}	1.00	1.9	12^{a}	150.7^{a}	25.57	6.0^{a}	25.5	106^{bc}	32.1	16.4	8.5	2.4	6.0^{b}	2.3	1.6	111^{ab}	141^{ab}	18.07^{bc}	7.05^{ab}
NR11375	45.6^{c}	0.9	2.1	11^{ab}	131.7^{cd}	24.03	6.1^{a}	25.7	129^{ab}	23.3	23.6	8.8	2.4	5.9^{b}	2.3	1.7	109^{bc}	139^{bc}	17.69^{bc}	6.62^{ab}
NR11374	39.5^{d}	0.9	2.0	11^{ab}	119.3^{d}	24.30	4.9^{a}	24.3	145^{a}	51.0	18.5	8.5	2.4	6.4^{b}	2.3	1.6	108^{bcd}	138^{bcd}	16.8^{bcd}	6.29^{ab}
IR08FAN10	37.7^{d}	1.5	2.3	12^{a}	98.8^{e}	23.77	5.6^{a}	25.4	86^{c}	65.3	22.7	8.9	2.2	6.9^{a}	2.3	1.8	104^{cd}	134^{cd}	16.3^{cd}	5.79^{b}
Khumal4	48.7^{bc}	0.9	2.1	10^{bc}	131.7^{cd}	23.6	2.8^{b}	26.5	141^{a}	26.1	17.1	8.9	2.2	6.0^{b}	2.1	1.6	106^{d}	136^{d}	12.5^{d}	4.29^{c}
Mean	46.6	1.0	2.2	10.99	130.5	24.1	5.3	25.4	127.4	36.6	19.8	8.8	2.4	6.3	2.3	1.7	109	139.5	18.4	6.38
P-value	***	ns	ns	*	***	ns	*	ns	*	ns	ns	ns	ns	*	ns	ns	**	**	***	**
LSD (0.05)	0.1	-	-	1.5	13.2	-	1.8	-	33.8	-	-	-	-	0.5	-	-	4.8	4.8	4.4	1.4
CV%	41.8	20.8	13.3	9.7	13.3	4.7	27.1	4.5	20.9	54.7	27.0	5.9	15.5	6.3	4.7	6.4	3.9	3.0	24.8	19.0

Note: LBL= Leaf blade length, LBW= Leaf blade width, GL= Glume length, TN/P= tiler number/plant, PH= Plant height, SL=Spike length, PdL= Peduncle length, PL= Panicle length, GN/P= Grains number/ Panicle, St.= Sterility %, TGW=Thousand Grain Weight, GL= Grain Length, GW= Grain Width, DCGL= Decorticated Grain Length, DCGW= Decorticated Grain Width, DGS= Decorticated Grain Shape, DH= Days to 50% Heading, DM= Days to 80% Maturity, SY=Straw Yield, GY= Grain Yield.

3.2.2 Agro-morphological characteristics study of prerelease wheat genotypes, Khumaltar.

Introduction:

Wheat (*Triticum aestivum* L.) is third major food crop next to rice and maize in Nepal. It was cultivated on 70,6843ha of land with production of 19,49001 mt and productivity of 2.67t/h (MOALD, 2019/20). It contributes significant role in the agricultural system of Nepal. The uniqueness of a particular variety is to be established by the test called DUS. In Nepal, DUS testing is basic requirement to prepare descriptor for easy understanding of the traits and varietal identification characters by all concerned stakeholders. The conservation and characterization of these genetic resources is a necessity not only for posperity, but also for utilization in different varietal improvement programs. These will be useful for breeders, researchers and farmers to identify and choose the restoration and conservation of beneficial genes. Morphological characterization is the foundation of genetic diversity research at any taxonomic level. It is still an important tool for the management of crop germplasm collections. It has been used to identify duplicates, to discriminate among germplasm from different geographic areas, to establish core collections, to investigate relationships between landraces and their wild forms and relatives, prioritize germplasm to use in breeding programmes. Agro-morphological characterization of genotypes/varieties as a series of works have been carried out and the descriptors of the pipeline genoypes of wheat made available to support in variety registration and release process.

Materials and methods:

A total of ten prerelease genotypes along with two released varieties namely; WK3167, WK3164, WK2834, WK2787, WK3005, WK2891, WK3166, WK3163, WK2820, WK3165, Chyakhura and standard check variety WK1204 were received from NPGRC. Trial was conducted at NSSTRC, Khumaltar during winter season, 2020/2021. Experiment was laid out in RCBD with three replications and twelve treatments. Recommended seed rate was 120kg/ha. Seeding was done on 4th, Dec, 2020. The plot size was of 1.25m×3m with a rows spacing of 25cm with continuous seeding. Recommended dose of chemical fertilizer was applied @120:60:40 Kg NPK ha^{-1}. Half dose of N and full dose of P_2O_5 and K_2O was applied as a basal dose and remaining half of N was again divided in to two split doses i.e. first half was applied at tillering stage and remaining half at booting stage. Irrigation was managed as per the plant growth stages and moisture level in soil. Quantitative and qualitative data were recorded from the net harvested area from each plot excluding the boarder rows. Five randomly selected tiller/hills were tagged with marker to record the data. All data were

recorded from selected hills except grain yield and biomass yield. Data were processed and analyzed by using R stat.

Results and discussion:

Variation in qualitative traits:

Significant variation was observed for most of the qualitative traits. Plant growth habit was prostrate type in WK2787 and erect in WK3166 as compared to check variety WK1204 which had semi-erect growth habit. Foliage colour was green in WK2787, WK3005 and WK2820 while check variety WK1204 had dark green foliage colour. Flag leaf hairs on auricle was strongly present in WK2787, WK2891, WK3166 and WK2820. Frequency of plants with recureved flag leaves were higher in WK2787, WK3163, WK2820, Chyakhura and WK3165 while low in check variety WK1204. Flag leaf attitude at early observation was semi-erect in WK2843, WK3167, WK3005, WK3166 and drooping in WK2787, WK3163, WK2820, Chyakhura and WK3165. Flag leaf glaucosity and waxiness of sheath was very strong in WK3167, WK2891, WK3166, WK3163, WK2820, Chyakhura, WK3165, WK3164 and strong in WK2843, WK2787 and WK3005 while medium in check variety WK1204. Ear density was dense in WK3167, WK2787 and WK3166. Scur was very long in WK2891, WK3166, Chyakhura and WK3165. Apical rachis segment, hairiness of convex surface was weak in WK3167, WK2820 and WK3166. Lower glume shoulder width was medium type in WK3167, WK2787, WK3005 and WK2820 while narrow in WK2843, WK3166, WK3163 and WK3165. Lower glume beak length was very long in WK2891, WK3166, WK2820, WK3165 and medium in WK3167. Lower glume beak shape was straight in WK3167, WK2787, WK3005, Chyakhura and WK3164 as compared to check variety WK1204 which was slightly curved. Spike attitude at maturity stage was straight in WK3167 while drooping in WK3163 and WK2820. Detail results are illustrated in table 5.

Table 5: Variation in qualitative traits of pre-release wheat genotypes evaluated in mid hill environment, Khumaltar

Genotypes	PGH	C:AC	FC	FL:HA	P:FPRFL	FLA	FL:GS	WS	E:G	C:GN	E:D	Scurs	EC	OG:P	ARS:HCS
WK3167	Semi-erect	Absent	Dark green	Medium	Medium	Semi-erect	Very strong	Very strong	Medium	Very strong	Dense	Short	Colored	Medium	Weak
WK1204	Semi-erect	Absent	Dark green	Medium	Low	Erect	Medium	Medium	Medium	Medium	Medium	Long	White	Absent	Absent or v.weak
WK2843	Semi-erect	Absent	Dark green	Medium	Medium	Semi-erect	Strong	Strong	Strong	Strong	Medium	Long	White	Absent	Absent or v.weak
WK2787	Prostrate	Absent	Green	Strong	High	Drooping	Strong	Strong	Strong	Strong	Dense	Short	White	Absent	Absent or v.weak
WK3005	Semi-erect	Absent	Green	Medium	Medium	Semi-erect	Strong	Strong	Strong	Strong	Medium	Short	White	Absent	Absent or v.weak
WK2891	Semi-erect	Absent	Dark green	Strong	Low	Erect	Very strong	Very strong	Strong	Very strong	Medium	V.long	White	Absent	Absent or v.weak
WK3166	Erect	Absent	Dark green	Strong	Medium	Semi-erect	Very strong	Very strong	Very strong	Very strong	Dense	V.long	White	Absent	Weak
WK3163	Semi-erect	Absent	Dark green	Medium	High	Drooping	Very strong	Very strong	Strong	Very strong	Medium	Long	White	Absent	Absent or v.weak
WK2820	Semi-erect	Absent	Green	Strong	High	Drooping	Very strong	Very strong	Strong	Very strong	Medium	Long	White	Absent	Weak
Chyakhura	Semi-erect	Absent	Dark green	Medium	High	Drooping	Very strong	Very strong	Strong	Very strong	Medium	V.long	White	Absent	Absent or v.weak
WK3165	Semi-erect	Absent	Dark green	Strong	High	Drooping	Very strong	Very strong	Strong	Very strong	Medium	V.long	White	Absent	Absent or v.weak
WK3164	Semi-erect	Absent	Dark green	Strong	Low	Erect	Very strong	Very strong	Strong	Very strong	Medium	Long	White	Absent	Absent or v.weak

Contd.

Genotypes	LGSW	LGSS	LG:BL	LG:BS	LG:EIH	LL:BS	G:S	SA	GS	G:GW	GM	SCD	SCW	IHG
WK3167	Medium	Sloping	Medium	Straight	Weak	Straight	Amber	Straight	Ovate	Medium	Absent	Mid-deep	Midwide	Present (Group III)
WK1204	Broad	Straight	Long	Slightly curved	Weak	Slightly curved	Amber	Erect	Ovate	Medium	Absent	Mid-deep	Midwide	Present (Group I)
WK2843	Narrrow	Slightly sloping	Long	Slightly curved	Weak	Slightly curved	Amber	Erect	Oblong	Wide	Absent	Narrow	Narrow	Present (Group I)
WK2787	Mediumzzzz	Sloping	Medium	Straight	Weak	Straight	White	Erect	Oblong	Narrow	Absent	Narrow	Narrow	Present (Group I)
WK3005	Medium	Sloping	Medium	Straight	Weak	Straight	Amber	Erect	Ovate	Medium	Present	Mid-deep	Midwide	Present (Group I)
WK2891	Broad	Straight	Very long	Slightly curved	Weak	Slightly curved	Amber	Erect	Oblong	Medium	Absent	Mid-deep	Midwide	Present (Group I)
WK3166	Narrrow	Sloping	Very long	Slightly curved	Weak	Slightly curved	White	Erect	Oblong	Medium	Absent	Narrow	Narrow	Present (Group I)
WK3163	Narrrow	Sloping	Long	Slightly curved	Weak	Slightly curved	White	Drooping	Oblong	Medium	Present	Narrow	Narrow	Present (Group I)
WK2820	Medium	Sloping	Very long	Slightly curved	Weak	Slightly curved	Amber	Drooping	Oblong	Medium	Present	Mid-deep	Midwide	Present (Group I)
Chyakhura	Broad	Straight	Long	Straight	Medium	Straight	White	Erect	Oblong	Medium	Present	Narrow	Narrow	Present (Group II)
WK3165	Narrrow	Sloping	Very long	Slightly curved	Medium	Slightly curved	White	Erect	Oblong	Medium	Present	Narrow	Narrow	Present (Group I)
WK3164	Medium	Sloping	Long	Straight	Weak	Straight	Amber	Erect	Ovate	Narrow	Present	Mid-deep	Midwide	Present (Group I)

Note:PGH=Plant growth habit, C:AC=Coleoptile:Anthocyanin colouration, FC= Foliage colour, FL:HA Flag leaf:hairs on auricle, P:FPRFL= Plant:Frequency of plants with recureved flag leaves, FLA=Flag leaf attitude:(Early observation), FL:GS= Flag leaf:Glaucosity of sheath, WS= Waxiness of sheath, E:G= Ear:glaucosity, C:GN= Culm:glaucosity of neck, E:D=Ear: density, EC=Ear colour, OG:P= Outer glume:pubescence, ARS:HCS=Apical rachis segment:hairiness of convex surface, LGSW= Lower glume shoulder width (spikelet in mid third hair), LGSS= Lower glume shoulder shape, LG:BL=Lower glume:beak length, LG:BS=Lower glume:beak shape, LG:EIH= Lower glume:extent of internal hairs, LL:BS= Lowest lemma:beak shape, G:S= Grain: colour, SA=Spike attittude (at maturity), GS= Grain shape, G:GW=Grain:germ width, GM= Grain mark, SCD=Seed crease depth, SCW= Seed crease width, IHG=Internal hair group

Variation in quantitative traits:

Significant differences were observed in most of the quantitative traits. Among the tested genotypes; Chyakhura had the longest (12.66cm) spikelt length of 12.66cm and WK2787 had the shortest spikelet length of 9.40cm. Sterility% was maximum in WK2891 (5.0%) and minimum in WK3005 (2.4%). Genotype WK2820 was observed to have higest number of spikelets per spike and number of grains per spike. Awn length was longest of 8.16cm in WK3166 and shortest awn length of 6.41cm in WK3163. Peduncle length was longest of 20.48cm found in Chyakhura and shortest peduncle length (7.6cm) in check variety WK1204. Similarly panicle length (11.6cm) and culm diameter (4.5mm) was maximum in WK3165 and minimum panicle length (8.96 mm) and culm diameter (3.7mm) in WK2891. Early maturing genotype was WK3165 (158 days) and late maturing genotype was WK3050 (167 days). Genotype WK3005 was observed to have highest grain yield (4.73tha^{-1}) and WK3165 had lowest grain yield and this yield was at par with WK3164 (3.6 tha^{-1}). Detail results are given in table 6.

Table 6: Variation in quantitative traits of pre-release wheat genotypes evaluated in mid hill environment, Khumaltar

Genotypes	FLL cm)	FLW (cm)	SL (cm)	S%	NoS/S	NG/S	AL cm)	SL (mm)	SW (mm)	SD (mm)	TGW (gm)	No.A	No.G/S	WG/S	CN	PH (cm)	PL (cm)	PNL (cm)	CD (mm)	DH	DM	SY (tha^{-1})	GY (tha^{-1})
WK3167	21.8	1.7^{abc}	11.9^{abc}	2.4^{e}	19^{abcd}	49^{abcde}	7.3^{bcd}	6.7	3.8	2.7	60.3	2	3.6	3.2	11	91.4	14.4^{cd}	10.7^{abc}	4.3^{ab}	109	162^{abc}	7.7	4.3^{abcd}
WK1204	23.5	1.9^{a}	11.0^{cde}	3.6^{abcde}	17^{de}	47^{bcde}	6.7^{de}	6.4	3.8	3.2	55.9	2	3.6	3.5	11	91.9	7.6^{g}	10.1^{cd}	3.9^{bcd}	119	166^{ab}	9.0	4.6^{ab}
WK2843	21.6	1.7^{abc}	11.5^{bcd}	3.2^{bcde}	19^{abc}	50^{abcd}	7.2^{bcd}	6.5	3.7	3.0	54.1	3	3.8	3.2	9	92.2	13.0^{def}	11.1^{ab}	3.6^{cd}	108	161^{bcd}	7.2	4.2^{bcd}
WK2787	20.4	1.6^{bcd}	9.4^{f}	4.4^{abc}	17^{e}	42^{ef}	8.1^{a}	6.3	3.8	3.1	50.7	2	3.8	2.4	11	97.2	16.6^{bc}	9.5^{de}	3.7^{cd}	114	163^{abc}	7.6	4.0^{de}
WK3005	21.7	1.7^{abc}	12.2^{ab}	2.4^{e}	20^{ab}	54^{ab}	6.9^{cde}	6.5	3.6	3.1	53.3	2	3.8	3.1	12	98.0	17.9^{ab}	10.8^{abc}	3.8^{cd}	114	167^{a}	8.4	4.7^{a}
WK2891	24.0	1.7^{abc}	10.1^{ef}	5.0^{a}	17^{de}	44^{def}	7.6^{abc}	6.8	3.7	3.3	53.8	2	3.6	3.1	11	89.8	10.8^{fg}	8.9^{e}	3.6^{d}	115	166^{ab}	9.7	4.5^{ab}
WK3166	15.3	1.3^{d}	10.9^{de}	4.6^{ab}	18^{bcde}	46^{cdef}	8.1^{a}	6.6	3.6	3.0	52.9	2	3.7	2.8	10	93.2	12.3^{def}	10.7^{abc}	3.9b^{cd}	108	161^{cd}	7.8	4.1 ^{cd}
WK3163	20.2	1.5^{cd}	1.1^{cde}	3.2^{bcde}	18^{cde}	51^{abcd}	6.4^{e}	6.6	3.8	3.3	54.9	2	3.4	3.9	11	92.4	14.0^{cde}	9.5^{de}	4.0^{abcd}	111	161_{cd}	8.7	4.3^{abcd}
WK2820	20.4	1.6^{cd}	2.0^{abc}	2.7^{de}	20^{a}	55^{a}	8.0^{ab}	6.8	3.7	3.0	58.6	2	3.4	3.7	9	95.7	10.5^{fg}	10.3^{bcd}	4.0^{abc}	115	161^{cd}	7.8	4.5^{abc}
Chyakhura	24.0	1.7^{abc}	12.6^{a}	2.8^{cde}	20^{ab}	52^{abc}	7.0^{cde}	6.8	3.8	3.1	55.4	2	3.6	4.3	8	98.8	20.4^{a}	11.2^{ab}	4.3^{ab}	110	165^{abc}	8.5	4.5^{abc}
WK3165	26.2	1.8^{ab}	1.6^{bcd}	4.2^{abcd}	18^{cde}	40^{f}	7.0^{cde}	6.7	3.8	3.0	52.0	1	3.6	3.1	13	94.7	15.4^{bcd}	11.6^{a}	4.5^{a}	115	158^{d}	7.7	3.6^{e}
WK3164	19.2	1.6^{bcd}	1.4^{bcd}	$.3^{bcde}$	8^{bcde}	42^{ef}	6.2^{e}	6.4	3.6	3.1	55.5	2	3.2	3.1	7	92.1	11.0^{ef}	10.6^{bc}	3.9^{bcd}	112	162^{bcd}	7.2	3.6^{e}
Mean	21.5	1.6	11.3	3.5	18.2	47.7	7.2	6.6	3.7	3.1	54.8	2	3.6	5.3	10	93.9	13.7	10.4	4.0	112	163	8.1	4.3
P-value	ns	*	***	*	*	**	***	ns	ns	ns	ns	ns	ns	ns	ns	ns	***	***	*	ns	*	ns	***
LSD(0.05)	-	0.2	1.0	1.6	1.8	7.1	0.80	-	-	-	-	-	-	-	-	-	3.1	0.9	0.4	-	4.4	-	0.4
CV%	17.9	12.7	9.0	33.7	7.7	12.4	1.0	4.0	7.3	7.3	6.8	16.2	9.4	21.6	24.3	4.9	27.6	9.0	8.5	4.4	2.0	14.2	9.4

Note: FLL=Flag leaf length (cm), FLW= Flag leaf width (cm), SL= Spikelet length, S%= Sterility percent, No.S/S=No. of spikelet/spike, NG/S=No of grains/spike, AL=Awn length (cm), SL= Seed length (mm), SW= Seed width (mm), SD= Seed depth (mm), TGW= 1000 Grain Weight (g), No.A=No of grains at apex, No.G/S=No of grains per spike, WG/S=Wt. of grains/spike, CN=culm number, PH= Plant height (including awn),), PL= Peduncle length (cm), PNL=Panicle length(cm), CD= Culm diameter (mm) , DH= Days to 80% heading, DM= Days to 80% maturity, , SY=Straw Yield, GY=Grain Yield.

3.2.3 Agro-morphological characteristics study of promising finger millet genotypes

Introduction:

Finger millet (*Eleusine coracana* Gaertn) is an annual herbaceous plant belonging to tribe Eragrostidae and family Poaceae. It is a tetraploid (2n=4x=36) and self-pollinating species probably evolved from its wild relative *Eleusine Africana*. It is the fourth most important food crop in mid hills and high hills of Nepal. It plays a vital role in the livelihood in these areas. The total cultivated area of finger millet is 2,63,497 ha of land with productivity of 1.19t/ha (MoALD, 2019/2020). It is pre-dominantly grown under maize/millet relay system in mid-hills of western, central and eastern regions whereas in the hilly areas of mid and far western region, it is grown as mono crop. The concept of distinctness, uniformity and stability are thus fundamental to the characterization of a variety as a unique creation. Agro-morphological characterization of germplasm accessions is fundamental in order to provide information for plant breeding programs. Qualitative characters are significant for plant description. In Nepal, DUS testing is basic requirement to prepare descriptor for easy understanding of the traits and varietal identification characters by all concerned stakeholders. The conservation and characterization of these genetic resources is a necessity not only for posperity, but also for utilization in different varietal improvement programs. Morphological characterization is the foundation of genetic diversity research at any taxonomic level. The adequate characterization and evaluation are criterion both for the effective management and use of plant germplasm in breeding program. Characterization was done by NSSTRC to achieve the following objectives.

Objective:

- To characterize the released and pre release genotypes for variety identification and release/registration process.
- To maintain the genetic purity of released and prerelease varieties/genotypes.

Materials and methods:

Released and prerelease varieties/genotypes were received from Hill Crops Research Program (HCRP), Kabre, Dolakha. The experiment was laid out in RCBD design with three replications. Eight genotypes/varieties namely; Dalle-1, Okhle-1, KLE-159, Kabre kodo-1, KLE-236, Sailung kodo-1, KLE-158 and Kabre kodo-2 were studied. Area of each plot was 3m×1.2m. Seed rate was @10 kg/ha. Direct seeding was done in rows of 30cm apart and continuous seeding. Seeding was done on June 10, 2020 (2077/02/28). Similarly space maintained plant to plant after thinning. Recommended dose of chemical fertilizer was 40:30:20 kg N,P_2O_5,K_2O /ha. Other cultural practices were followed based

on guide lines provided by HCRP, Kabre. The quantitative characteristics including agronomic and phenological traits were statistically analyzed by using ANOVA in RSTAT software. Traits viz., growth habit, plant pigmentation at leaf juncture, glume colour, ear shape, finger branching, finger multiple whorl, seed colour, plant height, flag leaf length, flag leaf width, peduncle length, ear head length, grain yield (ton/ha) and biomass yield (ton/ha) were calculated from net harvested area.

Results and discussion:

Variation in qualitative traits:

Different qualitative characteristics were studied. Regarding quatitative traits, leaf: pubescence, stem: culm branching, finger: position of branching, seed shape, seed: surface, pericarp: persistence after threshing were found similar among genotypes. Rest of the traits were significantly differed. Plant growth habit was decumbent type in Dalle-1, Okhle-1 and Kabre Kodo-1. Plant pigmentation at leaf juncture was present in KLE-159, KLE-236, Sailung Kodo-1 and Kabre Kodo-2. Light purple glume colour was in KLE-159, KLE-236 and Kabre kodo-2. Open type ear shape was in Dalle-1, Kabre kodo-1 and fist type in Kabre Kodo-2. Finger branching was present in thumb finger with multiple whorl in KLE-159, KLE-236, Sailung kodo-1 and KLE-158. Enclosed type seed covered by glumes was present in KLE-158 and Kabre Kodo-2. Seed colour was dark brown in Dalle-1, KLE-158 and light brown in remaining genotypes. This qualitative characterization will be useful in variety release/registration process, seed variety identification and maintenance breeding. Detail results are given in table 7.

Table 7: Variation in qualitative traits of finger millet varieties/genotypes evaluated in mid hill environment, Khumaltar.

Genotypes	Growth habit	Plant: Pigmentation at leaf juncture	Glume Color	Ear : Shape	Finger: Branching	Finger: Multiple Whorl	Seed: Covering by Glumes	Seed: Color
Dalle-1	Decumbent	Absent	Light green	Open	Absent	In all fingers	Intermediate	Dark brown
Okhle-1	Decumbent	Absent	Light green	Compact	Absent	In all fingers	Intermediate	Light brown
KLE 159	Erect	Present	Light purple	Compact	Present	In thumb finger	Intermediate	Light brown
Kavre Kodo-1	Decumbent	Absent	Light green	Open	Absent	In all fingers	Intermediate	Light brown
KLE- 236	Erect	Present	Light purple	Compact	Present	In thumb finger	Intermediate	Light brown
Sailung-1	Erect	Present	Light green	Compact	Present	In thumb finger	Intermediate	Light brown
KLE -158	Erect	Absent	Light green	Compact	Present	In thumb finger	Enclosed	Dark brown
Kavre Kodo- 2	Erect	Present	Light purple	Fist	Absent	In all fingers	Enclosed	Light brown

Variation in quantitative traits

The results of ANOVA showed that significant difference was found in plant height and thousand grain weight. Longest ear head length (10.51cm) and finger length (9.44cm) was found in Kabre Kodo-1. Similarly shortest ear head length in KLE-236 (7.2cm) and finger length in Sailing Kodo-1 (5.7cm). Earliest maturing genotype was KLE-236 (122 days) and very late maturing variety was Dalle-1(159 days). Detail results are presented in table 8.

Table 8: Variation in quantative traits of finger millet varieties/genotypes evaluated in mid hill environment, Khumaltar.

Genotypes	Plant height (cm)	Flag leaf blade length (cm)	Flag leaf blade width (cm)	Peduncle length (cm)	Ear head length (cm)	Finger length (cm)	Finger width (cm)	1000 grain weight (gm)	Days to 50% flowering	Days to 50% maturity	Biomass (tha^{-1})	Yield (tha^{-1})
Dalle-1	159.6[a]	33.7	0.9	13.8	9.5[ab]	7.0[cd]	1.1	2.7[e]	96	159[a]	12.1	2.05
Okhle-1	137.2[b]	32.4	0.9	15.3	9.5[ab]	9.2[ab]	0.9	3.1[cd]	97	137[b]	10.1	2.15
KLE- 159	126.4[b]	28.6	1.1	11.6	9.7[ab]	7.9[bc]	1.1	3.7[a]	100	126[b]	10.3	2.55
Kavre Kodo-1	135.7[b]	33.6	0.9	11.8	10.5[a]	9.4[a]	0.9	3.2[bc]	96	135[b]	10.1	2.70
KLE 236	122.4[b]	32.4	0.8	15.4	7.2[c]	6.6[cd]	1.1	3.0[cd]	98	122[b]	8.5	2.22
Sailung kodo-1	138.2[b]	29.2	0.7	16.1	8.2[bc]	5.7[d]	1.1	3.4[b]	99	138[b]	10.8	2.45
KLE-158	125.8[b]	30.4	1.0	14.8	8.0[bc]	6.7[cd]	1.0	2.9[de]	96	125[b]	11.0	2.74
Kavre Kodo-2	136.6[b]	32.2	0.8	14.8	7.4[c]	6.4[d]	1.1	3.7[a]	98	136[b]	9.8	1.81
Mean	135.2	31.5	0.9	14.2	8.8	7.4	1.0	3.26	97	135	10.3	2.33
P-value	*	ns	ns	ns	*	**	ns	*	ns	*	ns	ns
LSD(0.05)	18.4	-	-	-	1.8	1.3	-	0.2	10.0	18.4	-	-
CV%	10.6	8.4	18.8	16.1	16.2	19.2	5.3	11.9	5	10.6	21.4	24.51

3.2.4 Agro-morphological characteristics study of promising buckwheat genotypes

Introduction:

Buckwheat is a minor food and cash crop of Nepal holding an area of 10, 296 ha with a productivity of 1.11 ton/ha (MOALD, 2019/20). This crop is grown as a summer crop in the high hills, autumn and spring crop in mid hills, and winter crop in Terai. Two types of cultivated buckwheat are grown by the farmers in Nepal. Tartary buckwheat (*Fagopyrum tataricum* Gaertn) is predominant in high hills whereas common/sweet buckwheat (*Fagopyrum esculentum* Moench) is grown mainly in mid hills and Terai. Tartary buckwheat is self pollinated while common buckwheat is cross pollinated crop. This crop is useful for human due to high nutritive and medicinal value. Buckwheat is cultivated science the Vedic era in Nepal. Therefore, both Tartary and Sweet buckwheat have a lot of variation in Nepalese context. A single qualitative trait is not enough to distinguish between the buckwheat landraces, however, a combination of growth habit, flower stalk color, flower color and seed surface is more useful. The diversity of these traits is higher in common buckwheat than Tartary buckwheat. The concept of distinctness, uniformity and stability are thus fundamental to the characterization of a variety as a unique creation. Agro-morphological characterization of germplasm accessions is fundamental in order to provide information for plant breeding programs. Qualitative characters are the most important characters to identify a plant variety and are mostly genetically controlled. Qualitative characters are significant for plant description. While the most predictable approach agro-morphological traits is applied to determine the relationships between genotypes. The adequate characterization and

evaluation are criterion both for the effective management and use of plant germplasm in breeding programs. In buck-wheat, although a few reports are available on agro-morphological diversity but no elaborate attempt has been made to extensively collect and assess di-versity among genotypes.

Material and methods:

Eight promising buckwheat genotypes viz. ACC#5671, ACC#9251, ACC#2194, ACC#2223-1, ACC#2213, ACC#227-1, ACC#6506, Kabre bitter and Mithe phapar-1 received from HCRP, Kabre, Dolakha for agro-morphological characterization during summer season 2020/21. Experiment was conducted at field of NSSTRC, Khumaltar. The experiment was laid out in RCBD with three replications and nine treatments. Seeding was done on 17th Sept, 2020. Chemical fertilizer was applied @ 30:20:10 N:P:K kg ha-1 . Half dose of N, K2o and P2o5 was used as basal dose. Remaining dose of N was top dressed afer 30 DAS. Plot size was 3m*1.5m with row to row spacing of 25cm and continuous seeding. After 15 days of emergence plants thinnedout to maintain 10cm spacing between plants. Interculture operations were carried out at different crop stages and when required. Data were recorded from the net harvested area (NHA). Five plants were randomly selected from NHA of each plot and tagged for data recording. The qualitative, quantitative and biochemical traits were recorded according to UPOV guide lines. Traits studied were viz.,growth and plant shoot habit, stem colour, leaf colour, leaf margin colour, leaf vein colour, petiole colour, colour of inflorescence of stalk, flower colour, seed colour, seed shape, flowering, maturity biomass yield etc.

Results and discussions:

Qualitative characterization buckwheat:

There was significant differences observed among genotypes for most of the qualitative traits. Cotyledon/seedling leaf colour was pink in ACC#5671, ACC#9251, ACC#2213, ACC#2271 and Kabre bitter. Plant growth habit and branch shoot habit was semi-erect and shorter in Mithephapar-1, ACC#2194, ACC#2223-1, ACC#6506 and semierect and longer in rest of the genotypes. Intermediate type of plant branching was observed in ACC#9251, Mithephapar-1 and ACC#2213. Red stem colour was observed in ACC#5671, ACC#9251, ACC#2213, ACC#2271 and Kabre bitter. Similarly pink stem color was observed in Mithephapar-1, ACC#2194, ACC#2223-1 and ACC#6506. Lodging was low in ACC#5671, ACC#2194, ACC#2223-1, ACC#2271, ACC#6506, Kabre bitter and medium in remaining genotypes. Petiole colour was pink in ACC#5671, ACC#9251, ACC#2213, ACC#2271, Kabre bitter and white petiole color in remaining genotypes. Leaf blade shape was hastate type in ACC#5671, ACC#2194, ACC#2223-1, ACC#2271, ACC#6506, Kabre bitter and sagitate type in ACC#9251, ACC#2244, Mithe phapar-1 and ACC#2213. Colour of inflorescence stalk was red in ACC#5671, ACC#9251, ACC#2213, ACC#2271, Kabre bitter and pink in remaining genotypes. Flower colour was

pinkish white in ACC#5671, ACC#9251, ACC#2213, ACC#22271 and Kabre bitter. Seed colour was brownish in ACC#5671, ACC#9251, ACC#2213, ACC#2271, ACC#6506 and Kabre bitter. Seed shape was ovate in ACC#5671, ACC#9251, ACC#2213, Kabre bitter and triangular in ACC#2271, ACC#6506. Threshability was easy in ACC#5671, ACC#9251, ACC#2213, Kabre bitter and difficult in ACC#2271. Detail results are presented in table 9.

Table 9: Variation in qualitative traits of buckwheat varieties/genotypes evaluated in mid hill environment, Khumaltar.

Genotypes	**ACC#5671**	**ACC#9251**	**Mithephapar-1**	**ACC#2194**	**ACC#2223-1**	**ACC#2213**	**ACC#2271**	**ACC#6506**	**Kabre bitter**
Cotyledon/seedling leaf colour	Pink	Pink	Green	Green	Green	Pink	Pink	Green	Pink
Growth and branch shoot habit	Semi-erect longer	Semi-erect longer	Semi-erect shorter	Semi-erect shorter	Semi-erect shorter	Semi-erect longer	Semi-erect longer	Semi-erect shorter	Semi-erect longer
Plant branching	Strong	Intermediate	Intermediate	Strong	Strong	Intermediate	Strong	Strong	Strong
Stem colour	Red	Red	Pink	Pink	Pink	Red	Red	Pink	Red
Lodging susceptibility	Low	Medium	Medium	Low	Low	Medium	Low	Low	Low
Petiole colour	Pink	Pink	White	White	White	Pink	Pink	White	Pink
Leaf blade shape	Hastate	Sagittate (Intermediate)	Sagittate (Intermediate)	Hastate	Hastate	Sagittate (Intermediate)	Hastate	Hastate	Hastate
Colour of inflorescence of stalk	Red	Red	Pink	Pink	Pink	Red	Red	Pink	Red
Flower colour	Pinkish white	Pinkish white	White	White	White	Pinkish white	Pinkish white	White	Pinkish white
Seed colour	Brown	Brown	Grey	Grey	Grey	Brown	Brown	Brown	Brown
Seed shape	Ovate	Ovate	Conoidal	Conoidal	Conoidal	Ovate	Triangular	Triangular	Ovate
Threshability	Easy	Easy	Intermediate	Intermediate	Intermediate	Easy	Difficult	Intermediate	Easy

Quantitative traits:

The results of ANOVA revealed that there was significant differences among genotypes regarding quantitative traits like stem diameter, number of flower cluster per cyme, 1000 grain weight. Stem diameter was highest (61.0mm) of genotype ACC#6506 and it was at par with ACC#2194, ACC#2223-1 and Mithephapar-1. Number of flower cluster per cyme was maximum (17) in ACC#6506. Among studied genotypes; ACC#9251 had highest (23.57gm) 1000 grain weight and lowest (18.21gm) in the genotype ACC#6506. There was no significant difference in grain yield among the genotypes. Detail results are presented in table 10.

Table 10: Variation in quantitative traits of buckwheat varieties/genotypes evaluated in mid hill environment, Khumaltar.

Genotypes	Plant Height (cm)	Number of Internode	Stem Diameter (mm)	Leaf Number	Petiole Length (cm)	Leaf Blade Length (cm)	Leaf Blade Width (cm)	Length of cyme (cm)	No. of Flowers cluster/ Ccyme	No.of Cymes /Plant	Number of seeds /Cyme	Seed Length (mm)	Seed Width (mm)	Thousand Grain Weight (gm)	Days to Flowering (50%)	Days to Maturity (75%)	Biomass Yield (kg ha^{-1})	Grain Yield (kgha^{-1})
ACC#5671	68.8	3	55.6^{b}	18^{ab}	12.2	3.1	2.5	4.1	12^{b}	3	16	5.3	3.0	22.9^{ab}	93	124	1062.9	254
ACC#9251	68.6	3	56.2^{b}	11^{c}	2.3	2.7	2.6	4.6	14b	3	13	5.5	3.1	23.5^{a}	93	124	918.5	239
Mithe phapar-1	86.0	5	60.7^{a}	19^{a}	2.0	2.6	2.5	5.5	15^{ab}	4	16	4.6	2.4	19.2^{bcd}	99	130	740.7	664
ACC#2194	84.5	5	60.7^{a}	15^{abc}	2.6	2.9	3.2	6.2	15^{ab}	4	13	4.6	2.5	20.8^{abcd}	99	130	625.9	477
ACC#2223-1	83.4	5	60.0^{a}	18^{a}	2.5	2.3	2.7	6.2	13^{b}	3	15	4.6	2.5	18.78^{cd}	99	130	637.0	486
ACC#2213	69.5	3	57.9^{ab}	12^{bc}	2.3	3.2	2.8	5.3	14b	3	12	5.4	3.3	22.3^{abc}	93	124	1066.6	248
ACC#227-1	71.1	3	58.3^{ab}	16^{abc}	2.7	3.1	2.7	5.7	15^{ab}	4	13	5.1	3.0	20.1^{abcd}	93	124	1114.8	309
ACC#6506	81.0	5	61.0 ^{a}	14^{abc}	2.3	2.6	3.1	6.7	17^{a}	4	15	4.8	2.5	18.2^{d}	93	124	551.8	426
Kabre bitter	75.0	3	59.0^{ab}	15^{abc}	2.5	2.8	2.2	5.0	15^{ab}	4	12	5.2	3.0	21.1^{abcd}	87	118	1029.6	261
Mean	76.4	4.3	58.8	15.7	2.4	2.8	2.7	5.5	14.7	4	14	5.0	2.8	20.7	94.7	125.3	860.9	374
P-value	ns	ns	*	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	*	ns	ns	ns	ns
LSD(0.05)	-	-	3.4	-	-	-	-	-	3.4		-	-	-	3.8	-	-	-	-
CV%	11.2	25.4	28.5	19.9	28.2	16.4	16.4	24.7	15.0	4.0	10	28.9	9.6	0.11	10	7.1	0.3	0.5

MULTILOCATION ACTIVITIES:

Assessment of polymer Zinc and Boron Seed Coating in wheat in Rice-wheat cropping system in terai, JRP, Ithari.

Materials and methods:

The experiment was laid out in RCBD with three replications along with eight treatments. It was conducted at NJRP, Itahari during winter season 2020/2021. Recommended seed rate was 120kg/ha. Seeding was done on 9th, Dec, 2020. The plot size was of 2.5m×4m with row to row spacing of 25cm. Wheat variety Aditya was coated with micronutrients and shade dried before sowing. The trial was consisted of eight different treatments viz: 0.75gm Borax, @1.5gm Borax, 3gm Borax, 2 gm Zinc Sulphate, 4 gm Zinc Sulphate, 6 gm Zinc Sulphate, 8 gm Zinc Sulphate per kg seed and control plot. Seeding was continuous manually. The dose of chemical fertilizer was 120:60:40 Kg NPK ha^{-1}. Half dose of N and full dose of P_2O_5 and K_2O was applied as a basal dose and remaining half of N was divided in to two split doses i.e. first half was applied at tillering stage and remaining half at booting stage. Irrigation was managed possibly as per the need up to grain filling stage. Five randomly selected tillers/hills selected and tagged with marker to record the data. All required data were recorded from selected five hills except grain yield and biomass yield. Data were processed and analyzed by using R stat.

Results and discussion:

There was no significant difference in any quantitative traits when wheat seed were coated with different concentration of micronutrients like zinc and boron. Detail results are given in table 11.

Table 11. Effect of seed coating on phenology, yield attributes and grain yield in Rice-wheat cropping system in terai, JRP, Ithari.

Treatment Number	Day to 50 % emergence	Days to 50% heading	Days to 50% maturity	No.of tiller /m^2	No.of spike /m^2	Plant height (cm)	Spike length (cm)	No.of spikelet /spike	No.of seed /spike	Thousand Grain wt gm)	Grain Yield (t/ha)	Straw Yield (t/ha)
0.75 gm Borax	5	66	112	295	292	88.8	10.0	15	42	48.0	3.68	5.3
1.5 gm Borax	6	68	115	233	228	88.3	8.3	14	32	44.8	2.94	4.3
3 gm Borax	6	67	115	252	248	86.9	9.4	16	41	47.7	3.09	4.7
2 gm ZnSo4	6	67	115	272	269	90.1	9.2	16	41	48.7	3.22	4.8
4 gm ZnSo4	6	67	115	291	289	93.4	8.9	15	42	45.1	3.70	5.3
6 gm ZnSo4	5	67	116	284	269	88.1	9.7	16	43	47.7	3.77	4.9
8 gm ZnSo4	5	67	114	310	306	92.0	8.6	13	35	44.5	3.75	5.5
Control	7	67	115	268	267	86.3	11.0	12	36	47.1	3.49	5.1
Mean	5.9	67.5	72.7	276	271.2	89.2	9.4	15.1	39.6	46.7	3.46	5.0
P-value	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
LSD (0.05)	-	-	-	-	-	-	-	-	-	-	-	-
CV%	11.5	1.1	1.6	14.5	15.3	4.7	16.2	11.8	17.2	6.8	16.77	16.6

Effect of micronutrient wheat seed coating in Rice-wheat cropping system of terai, NWRP , Bhairahawa

Materials and methods:

The experiment was laid out in RCBD with three replications and seven treatments. Trial was conducted at NWRP, Bhairahawa during winter season 2020/2021. Recommended seed rate was 120kg/ha. Seeding was done on 30th, Nov, 2020. The plot size was of 4m×2.5m with a spacing of 25cm*continuous seeding. Chemical fertilizer was applied @120:60:40 N:P:K Kg ha^{-1}. Wheat variety Aditya was coated with different micronutrients and dried under shade before sowing. The experiment consisted of seven different treatments viz T1=Farmer practice(1/2 NPK), T2=RDF NPK, T3=RDF NPK+(ZnSo4@2gm+Borax@1gm+Sodium Molybdate@0.5gm+Ferrous Sulphate@0.5gm)/kg, T4=T3-(ZnSo4@2gm/kg seed), T5=T3-(Borax@1gm/kg seed), T6=T3-(Sodium Molybdate @0.5g/kg seed, T7=T3-(Ferrous Sulphate@0.5g/kg seed. Half dose of N and full dose of P_2O_5 and K_2O was applied as a basal dose and remaining half of N was again divided in to two split doses i.e. first half was applied at tillering stage and remaining half at booting stage. Irrigation was managed as per the need of crop up to grain filling stage. Five tillers/hills selected randomly from NHA and tagged with marker to record the data. Data were processed and analyzed by using R stat.

Results and discussions:

There was significant difference in traits like thousand grain weight, grain yield and biomass yiled where highest thousand grain weight (46.5), grain yield (3.017 t ha^{-1}) and biomass yield (5.87 t ha^{-1}) was observed in the treatment where RDF NPK+ZnSo4 @ 2gm + Sodium Molybdate @ 0.5gm + Ferrous Sulphate @ 0.5gm) per kg seed was applied and lowest yield (2.27 tha^{-1}) and biomass (4.20 tha^{-1}) was observed in the treatment where ½ kg NPK (farmer practice) was applied. Similarly non- significant difference was observed in traits like days to 50% heading, days to 80% maturity, plant height, spike length, no. of tiller per square meter, number of grains per spike. Detail results are given in table 12.

Table 12. Effect of wheat seed coating on phenology, yield attributes and grain yield in Rice-wheat cropping system in terai, NWRP, Bhairahawa.

Treatments	Days to 80% Heading	Days to 80% Maturity	Plant Height (cm)	Spike Length (cm)	No of Tiller/m^2	Thousand Grain Wt (gm)	No.of Grains /Spike	Grain Yield (tha^{-1})	Biomass Yield (tha^{-1})
T1=Farmer practice(1/2kg NPK)	82	123	91.9	10.5	232	41.2c	48	2.27c	4.2b
T2=RDF NPK	82	123	92.7	10.6	274	42.0bc	53	2.93b	5.6a
T3= RDF NPK + (ZnSo4 @ 2gm + Borax @1gm+Sodium Molybdate @ 0.5 gm + Ferrous Sulphate@0.5gm)/kg	82	123	91.7	10.8	242	43.2b	50	2.89a	5.7a
T4=T3-(ZnSox4@2gm/kg seed)	82	123	91.5	10.4	234	42.4b	52	2.74a	5.6a
T5=T3-(Borax@1gm/kg seed)	82	123	91.9	11.0	252	46.5a	55	3.017a	5.8a
T6=T3-(Sodium Molybdate@0.5g/kg seed)	82	123	89.4	10.6	248	42.0b	48	2.96a	5.5a
T7=T3-(Ferrous Sulphate@0.5g/kg seed)	82	123	91.7	10.3	230	42.1b	53	2.97a	5.7a
Mean	82	123	91.5	10.6	245.1	42.8	51.6	2.83	5.5
P-value	ns	ns	ns	ns	ns	*	ns	**	*
LSD (0.05)	-	-	-	-	-	3.5	-	0.4	1
CV%	0.1	0.1	2.8	5.2	10	8.9	5.3	10.3	11.8

3.3 SEED VARIETY IDENTIFICATION USING DNA FINGER PRINTING TECHNOLOGY

3.3.1 Genetic diversity analysis of different Maize inbred lines using Siplme Sequence Repeat (SSR) markers

Introduction:

Maize (*Zea mays* L.) is one of the most important cereal crops and has the highest production area worldwide followed by wheat and rice (FAO 2012). Maize is among a priority commodity programmed by the Nepal government. Best crop improvements can be achieved by the identification of genetically distant parental combinations. Molecular marker technology provides effective, fast, accurate and appropriate tool for crop improvement. DNA markers have been used for varietal identification, seed purity testing, genetic similarity analysis and marker-assisted selection of crops in many species (Ajmone-Marsan et al 1998; Bornet & Branchard, 2001; Dangel et al 2001; Powell et al 1996; Mammadov et al 2010). SSRs, also known as microsatellites, are repeated sequences of DNA (Gül-İnce et al 2011) and they can easily detect both parental alleles because of their co-dominancy. However, maintenance of the genetic purity of hybrid seeds is of utmost importance and should be meticulously maintained, as it greatly influences the crop productivity. Assessment of genetic purity helps to minimize bio-security and quality risks to the farm business. Now-a-days, DNA fingerprinting approaches based on polymerase chain reaction and relying on various types of molecular markers have greatly replaced the earlier method of grow-out test for assessing genetic purity by obtaining a specific pattern or profile for each hybrid. DNA fingerprinting makes it possible to characterize the hybrid at various stages of plant development. Among the molecular markers, Simple Sequence Repeat (SSR) markers have been the marker of choice for genetic purity assays as co-dominant, highly polymorphic, multi-allelic and distributed throughout a wide range of genomic regions (Kostova et al. 2006, Kalia et al. 2011, Daniel et al. 2012). In the present study, DNA fingerprinting of twenty-five maize inbred lines using SSR markers was carried out in order to characterize them and develop their DNA fingerprint database for their future utilization in identification of these lines and authentication of genetic purity.

Materials and methods:

Germplasm

A total of 25 maize samples of inbred lines were reveived from NMRP, Rampur and used for microsatellite analysis. The details of inbred lines are presented in Table 13.

Table 13: List of maize inbred lines used in DNA finger printing.

Genotype code	Name of Variety	Genotype code	Name of Variety	Genotype code	Name of Variety
1	RML-2	10	RML-97-1	19	RML-95
2	RML-146	11	RL-36	20	RML-98
3	RML-96	12	RML-97-2	21	RL-180
4	RML-85	13	RL-232	22	RML-140
5	RML-138	14	RML-76	23	RML-17
6	RL-298	15	RML-11-1	24	RL-236
7	RML-88	16	RML-84	25	RL-105
8	RML-18	17	RML-83		
9	RML-145	18	RL-111		

Leaf material collection and DNA extraction:

Sample seeds were placed in plastic trays containing soil and germinated in seed germinator. Young and healthy leaves (2-3 cm long) from 8-14 days old seedlings were harvested. Total genomic DNA from the leaf samples was extracted following Cetyl-Trimethyl-Ammonium bromide (CTAB) based protocol described by Murray and Thompson (1980) with modification. The DNA extract in the form of pellet was suspended in 50µl of TE buffer and prepared 10% working DNA solution with deionized water. The extracts were stored at -20^{0}C.

SSR marker Genotyping:

A set of 20 SSR primer pairs were used. PCR reactions were conducted in a reaction volume of 15 µl, using 2 µl of template DNA with 7.5 µl of master mixture, 1.5 µl of each reverse and forward primers and 2.5 µl of sterile water. The PCR plates were placed in a thermal cycler machine for amplification of target DNA fragments and was programmed with condition of: initial denaturation at 94^{0}C for 4 min; 35 cycles of 1 min at 94^{0}C, annealing at 56-63^{0}C for 1 min, 1 min at 72^{0}C; and plus a final extension step at 72^{0}C for 6 min. In the thermal cycler, annealing temperature was set up appropriate for each primer pairs to ensure successful amplification.

Determination of microsatellite allele lengths:

SSR-PCR products were analyzed on 2.5% agarose gel, visualized by staining with ethidium bromide under short-wave UV light. 100 bp DNA ladder was used in the electrophoresis.

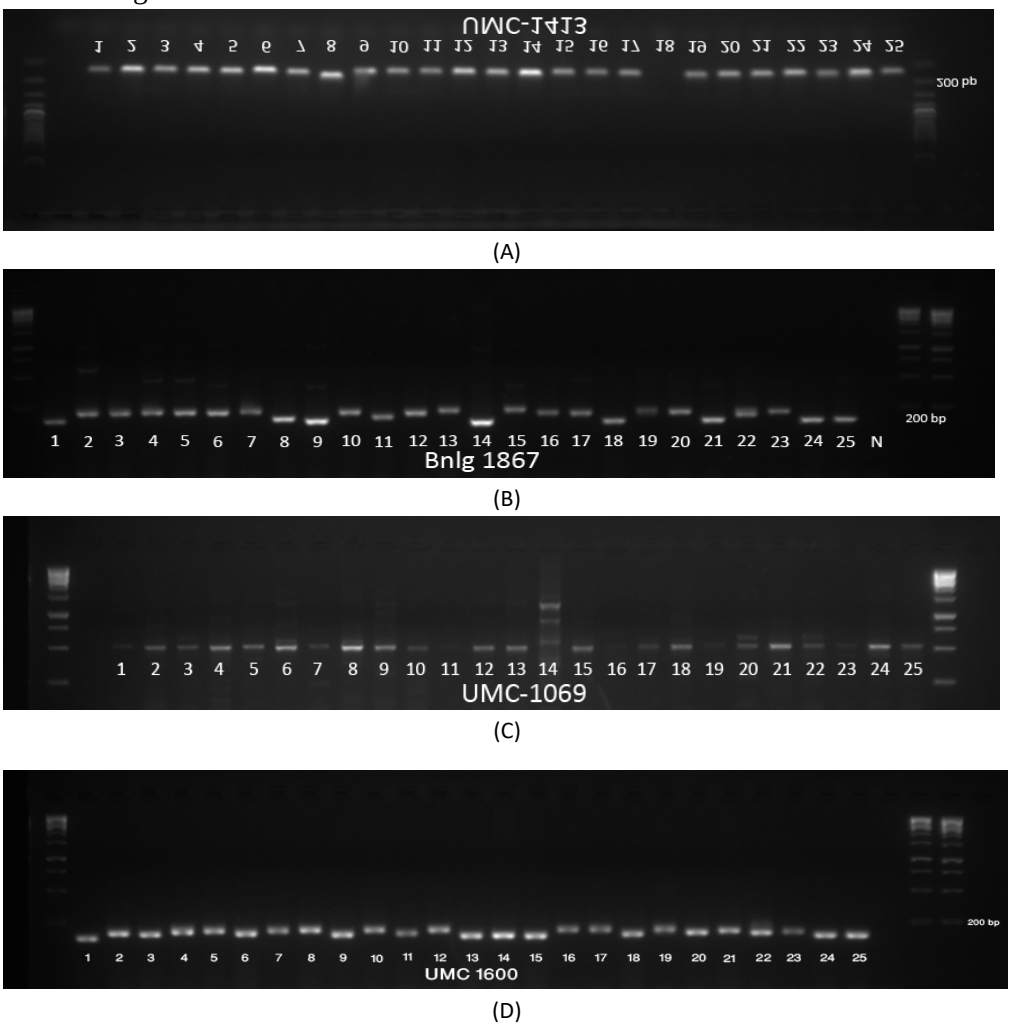
Data analysis:

The polymorphism percentage was calculated with different primers based on the banding pattern obtained. The presence of each informative band was measured, while its absence was scored as zero. The polymorphic information content was calculated

using the formula: $PIC=1-\Sigma(P_i)^2$, where, 'P_i' is the frequency of the i^{th} allele calculated for each microsatellite locus.

Results and Discussion:

In present study, 20 SSR primers were used to estimate genetic diversity among 25 genotypes, also the efficiency of markers were compared. All 25 maize cultivars were successfully amplified with the 18 microsatellite primer pairs whereas 2 primers showed no amplification. A total of 398 alleles were detected among all genotypes. The number of alleles per locus varied from 1.33 to 24. Banding patterns generated by primer pairs UMC-1413, Bnlg-1867, UMC-1069 and UMC-1600 in various maize cultivars are shown in Fig 1.



(A)

(B)

(C)

(D)

Fig 4. Amplification profiles of various maize inbred lines at the locus UMC-1413 (A) and Bnlg-1867 (B) and UMC-1069 (C) and UMC-1600 (D); L, Molecular wt. marker (100 bp ladder)

In the current studies, 16 out of 20 SSR primer pairs generated polymorphic bands. PIC values for SSR ranged from 0.0784 to 0.99 with mean value of 0.55. The highest PIC value was observed with primer Bnlg-1257. The detail demonstration of the diversity analysis of maize genotypes using SSR markers are presented in Table 2 and Table 3.

Table 14: Analysis of the DNA profiling (fingerprinting)/genetic diversity among various maize inbred lines

S.N.	Primer code	Molecular wt. range (bp)	Total no. of alleles	No. of polymorphic alleles	Alleles per locus	Polymorphism information content (PIC)
1	UMC1363	-	-	-	-	-
2	UMC1370	100-200	-	-	-	-
3	UMC1587	100-200	-	-	-	-
4	UMC1060	100-200	25	4	6.25	0.68
5	UMC1413	100-200	24	3	8	0.51
6	UMC1859	100-200	24	3	8	0.65
7	Bnlg 1867	100-200	25	5	5	0.73
8	Phi053	100-200	20	3	6.67	0.67
9	UMC1962	100-300	50	6	8.33	0.11
10	UMC1196	100-200	25	2	12.5	0.48
11	UMC1380	100-200	25	2	12.5	0.44
12	UMC1241	100-200	25	3	8.33	0.65
13	UmC2265	100-200	25	3	8.33	0.56
14	Bnlg 1257	100-200	4	3	1.33	0.99
15	UMC1600	100-200	25	4	6.25	0.67
16	UMC1630	100-200	24	1	24	0.078
17	UMC1069	300-400	27	5	5.4	0.59
18	Bnlg1810	-	-	-	-	-
19	UMC2013	100-200	25	4	6.25	0.54
20	Bnlg1189	100-200	25	4	6.25	0.49
			Total alleles = 398	Total polymorphic alleles = 55	Average alleles per locus = 8.34	Mean value of PIC = 0.55

Table 15: Diversity parameters among the maize inbred lines

Total sample analyzed	**25**
Total SSR markers tested	20
Total SSR markers amplified	18
Total polymorphic marker	16
Total monomorphic marker	2
% of polymorphic loci (marker)	80%
Total no. of alleles	398
Average alleles per locus (marker)	8.34
Total no. of polymorphic alleles	55
Allele per polymorphic loci	3.44

The result indicated that the SSR markers are neutral and co-dominant and could be a powerful tool to assess the genetic variability of the cultivars. The information about the genetic diversity will be very useful for proper identification and selection of appropriate parents for breeding programs, including gene mapping, and ultimately for emphasizing the importance of marker-assisted selection (MAS) in maize improvement worldwide. With the aid of microsatellite markers, different distantly related maize genotypes may be combined by intercrossing genotypes to get hybrid varieties with highest heterosis (Sajib et al., 2012). Markers with PIC values of 0.5 or higher are highly informative for genetic diversity studies and can be successfully used to distinguish the polymorphism at a specific locus.

DNA fingerprinting and genetic diversity analysis of different varieties of Aromatic Rice using Simple Sequence Repeat (SSR) markers

Rice (Oryza sativa L.) (2n=24) belonging to the family Graminae. Aromatic rice is one of the major types of rice comprising nutty aroma and taste. The aroma, flavor and texture of aromatic rice make it high graded in quality. Aromatic rice has very special values in Nepal. Many Nepalese aromatic rice landraces have been characterized and evaluated using morphological traits. However, inadequate approach have been made to study aromatic rice landraces at genetic level in Nepal. Modern biotechnology provides us molecular marker which is the powerful tool for determining genetic variation among rice landraces. In contrast to morphological traits molecular markers can reveal abundant differences among genotypes at the DNA level, providing a more direct, reliable and efficient tool for germplasm characterization, conservation and management not affected by environmental factors. SSR markers are more popular in rice because they are highly informative, mostly mono-locus, co-dominant, easily analyzed and cost effective (Prabakaran et al., 2010).

Objectives:

- To study the genetic diversity among the 95 aromatic rice accessions from different regions of Nepal.
- To prepare the DNA finger printing and genetic diversity analysis of aromatic rice landraces to measure the extent of genotypic differences and genetic relationship.
- To assist in broadening the germplasm base of future rice breeding programs.

Materials and methods:

Germplasm:

A total of 95 rice germplasm were used for microsatellite analysis. Sample seeds were provided by National Rice Research Program (NRRP), Hardinath, Dhanusha. A total of 50 simple sequence repeat (SSR) markers were used. The details of rice genotypes are presented in Table 16.

Table 16: List of aromatic rice landraces used in DNA finger printing, NSSTRC, Khumaltar.

Genotype code	Name of Variety	Genotype code	Name of Variety
1	NGRC 02107	51	Lalmunda
2	NGRC 03279	52	Kala Namak
3	NGRC 05881	53	Pant dhan-1
4	HGRC 03016	54	NGRC 05914
5	NGRC 03313	55	Basmati 370
6	NGRC 05866	56	NGRC 03070
7	NGRC 03308	57	Dulhaniya
8	NGRC 03009	58	NGRC 03283
9	NHRC 03306	59	NGRC 03103
10	NGRC 05893	60	NGRC 03396
11	NGRC 08136	61	NGRC 03040
12	NGRC 03343	62	NGRC 05913
13	NGRC 03338	63	NGRC 02112
14	Jagarnathiya	64	-
15	NGRC 03110	65	NGRC 03337
16	NGRC 05799	66	NGRC 05815
17	NGRC 03389	67	Jaswa
18	Samba Masuli Sub-1	68	NGRC 01905
19	NGRC 02111	69	NGRC 01850
20	NGRC 01908	70	NGRC 05829
21	NGRC 02115	71	NGRC 05890
22	NGRC 05877	72	Jaswa 2
23	RP Cross 1	73	NGRC 08137
24	Harinker	74	-
25	NGRC 02841	75	NGRC 05917
26	NGRC 05802	76	NGRC 01906
27	NGRC 05883	77	NGRC 02953
28	Sunaulo Sugandha	78	NGRC 05955
29	NGRC 03096	79	Ultra Super Sampurna
30	NGRC 01849	80	NGRC 05899
31	NGRC 01857	81	NGRC 05869
32	-	82	NGRC 05867
33	NGRC 05875	83	NGRC 03108

Genotype code	Name of Variety	Genotype code	Name of Variety
34	NGRC 05828	84	NGRC 03298
35	NGRC 05800	85	NGRC 03386
36	Karia Kamod	86	NGRC 01968
37	NGRC 03022	87	NGRC 01911
38	NGRC 02997	88	NGRC 02918
39	NGRC 01992	89	NGRC 03031
40	NGRC 04974	90	NGRC 03007
41	NGRC 05909	91	Sabitri
42	NGRC 05876	92	-
43	NGRC 05813	93	NGRC 05919
44	NGRC 03300	94	NGRC 05920
45	-	95	NGRC 03094
46	Pant dhan-2	96	Lalka Basmati
47	NGRC 05836	97	NGRC 03388
48	Das Basmati	98	NGRC 05873
49	NGRC 03039	99	NGRC 05953
50	NGRC 03020	100	NGRC 05798

Leaf material collection and DNA extraction:

Sample seeds were placed in plastic trays containing soil and germinated in seed germinator. Young and healthy leaves (2-3 cm long) from 8-12 days old seedlings were harvested. Total genomic DNA from the leaf samples was extracted following Cetyl-Trimethyl-Ammonium bromide (CTAB) based protocol described by Murray and Thompson (1980) with modification. The DNA extract in the form of pellet was suspended in 50µl of TE buffer and prepared 10% working DNA solution with deionized water. The extracts were stored at -20^{0}C.

SSR marker genotyping:

A set of 50 SSR primer pairs were used. PCR reactions were conducted in a reaction volume of 15 µl, using 2 µl of template DNA with 7.5 µl of master mixture, 1.5 µl of each reverse and forward primers and 2.5 µl of sterile water. The PCR plates were placed in a thermal cycler machine for amplification of target DNA fragments and was programmed with condition of: initial denaturation at 95^{0}C for 5 min; 35 cycles of 1 min at 94^{0}C, annealing at 52-58^{0}C for 1 min, 2 min at 72^{0}C; and plus a final extension step at 72^{0}C for 7 min. In the thermal cycler, annealing temperature was set up appropriate for each primer pairs to ensure successful amplification.

Determination of microsatellite allele lengths:

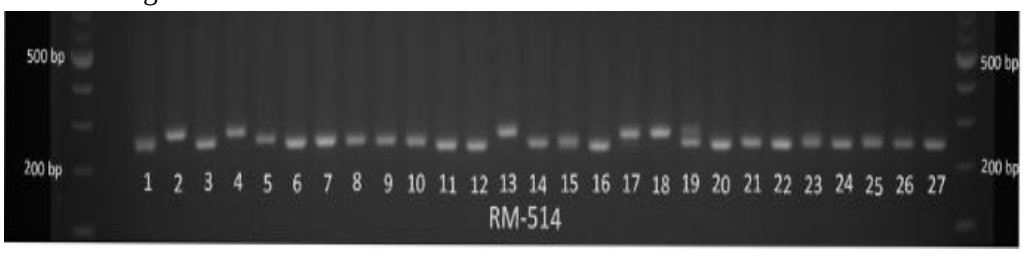
SSR-PCR products were analyzed on 2.5% agarose gel, visualized by staining with ethidium bromide under short-wave UV light. 100 bp DNA ladder was used in the electrophoresis.

Data analysis:

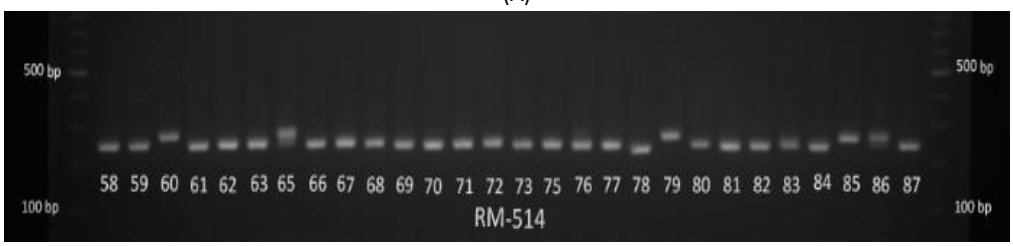
The polymorphism percentage was calculated with different primers based on the banding pattern obtained. The presence of each informative band was measured, while its absence was scored as zero. The polymorphic information content was calculated using the formula: $PIC=1-\Sigma(P_i)^2$, where, 'P_i' is the frequency of the i^{th} allele calculated for each microsatellite locus.

Results and Discussion:

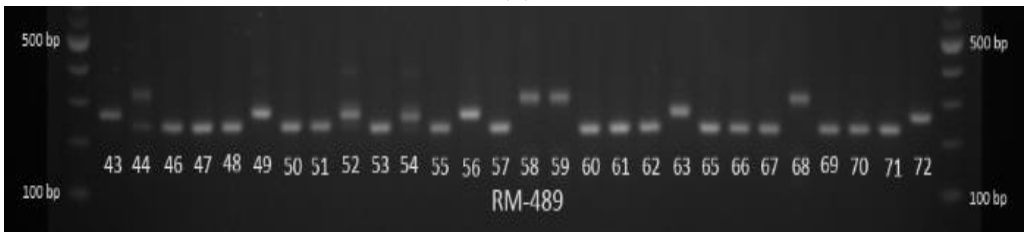
In present study, 50 SSR primers distributed from chromosome 1 to 12 were used to estimate genetic diversity among 95 genotypes. All 95 rice landraces were successfully amplified with the 43 microsatellite primer pairs whereas could not obtain clear amplification through 7 primers. A total of 1167 alleles were detected among all genotypes. The number of alleles per locus varied from 15.6 to 56. Banding patterns generated by primer pairs RM-21, RM-547 and RM-222 in various rice cultivars are shown in Fig 1.



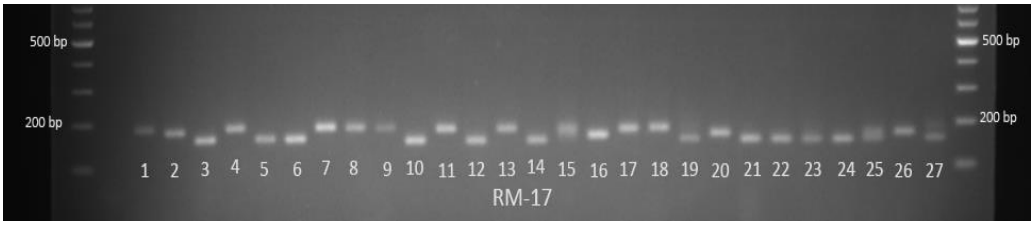
(A)



(B)



(C)



(D)

Fig 5. Amplification profiles of various aromatic rice (Oryza spp.) landraces at the locus RM-514 (A, B) and RM-489 (C) and RM-17 (D); L, Molecular wt. marker (100 bp ladder)

In the current studies, 33 out of 50 SSR primer pairs generated polymorphic bands. PIC values for SSR ranged from 0.02 to 0.75 with mean value of 0.44. The highest PIC value was observed with primer RM-19. The detail demonstration of the diversity analysis of rice genotypes using SSR markers are presented in Table 2 and Table 3.

Table 17: Analysis of DNA profiling (fingerprinting)/genetic diversity among various aromatic rice landraces

S.N.	Primer code	Chromosome location	Molecular wt. range (bp)	Total no. of alleles	No. of polymorphic alleles	Alleles per locus	Polymorphism information content (PIC)
1	**RM1**	1	<100	95	3	31.67	0.59
2	**RM495**	1	100-200	95	2	47.5	0.43
3	**RM259**	1	100-200	97	2	48.5	0.15
4	**RM5**	1	100-150	94	2	47	0.27
5	**RM240**	2	100-200	95	2	47.5	0.5
6	**RM213**	2	100-200	-	-	-	-
7	**RM207**	2	50-200	99	4	24.75	0.63
8	**RM5639**	3	100-150	97	3	32.33	0.53
9	**RM114**	3	NA	NA	NA	NA	NA
10	**RM3134**	3	150-200	-	-	-	-
11	**RM291**	5	200-300	-	-	-	-
12	**RM413**	5	<100	95	2	47.5	0.24
13	**RM334**	5	100-200	91	3	30.33	0.59
14	**RM510**	6	100-150	94	2	47	0.28
15	**RM190**	6	100-150	94	2	47	0.26
16	**RM217**	6	100-200	95	3	31.67	0.64
17	**RM234**	7	100-200	94	2	47	0.41
18	**RM223**	8	100-200	90	2	45	0.46
19	**RM195**	8	-	-	-	-	-
20	**RM108**	9	-	-	-	-	-
21	**RM107**	9	200-300	95	2	47.5	0.43
22	**RM258**	10	100-200	93	2	46.5	0.51
23	**RM224**	11	100-200	93	2	46.5	0.51
24	**RM209**	11	100-200	93	3	31	0.63
25	**RM17**	12	100-200	94	2	47	0.51
26	**RM19**	12	200-300	67	2	33.5	0.75
27	**RM124**	4	-	-	-	-	-
28	**RM248**	7	NA	NA	NA	NA	NA
29	**RM288**	9	NA	NA	NA	NA	NA
30	**RM311**	10	NA	NA	NA	NA	NA

S.N.	Primer code	Chromosome location	Molecular wt. range (bp)	Total no. of alleles	No. of polymorphic alleles	Alleles per locus	Polymorphism information content (PIC)
31	**RM271**	10	NA	NA	NA	NA	NA
32	**RM552**	11	100-200	92	3	30.67	0.67
33	**RM7376**	12	200-250	94	2	47	0.4
34	**RM122**	5	200-250	95	2	47.5	0.15
35	**RM140**	1	200-300	95	2	47.5	0.34
36	**RM154**	2	NA	NA	NA	NA	NA
37	**RM447**	8	-	-	-	-	-
38	**RM522**	1	100-200	95	2	47.5	0.02
39	**RM541**	6	100-300	95	3	31.67	0.56
40	**RM431**	1	200-300	95	2	47.5	0.49
41	**RM208**	2	200-300	95	2	47.5	0.32
42	**RM489**	3	200-300	94	3	31.33	0.49
43	**RM514**	3	200-300	95	2	47.5	0.27
44	**RM206**	11	100-200	94	3	31.33	0.59
45	**RM23**	1	-	-	-	-	-
46	**RM159**	5	-	-	-	-	-
47	**RM250**	2	100-200	93	2	46.5	0.44
48	**RM26**	5	-	-	-	-	-
49	**RM25**	8	100-200	95	2	47.5	0.49
50	**RM80**	8	NA	NA	NA	NA	NA
				Total alleles=1167	Total polymorphic alleles=77	Average allele per locus=31.83	Mean value of PIC=0.44

Table 18: Diversity parameters among the aromatic rice landraces

Total sample analyzed	95
Total SSR markers tested	50
Total SSR markers amplified	43
Total polymorphic marker	33
Total monomorphic marker	10
% of polymorphic loci (marker)	66%
Total no. of alleles	1167
Average alleles per locus (marker)	31.83
Total no. of polymorphic alleles	77
Allele per polymorphic loci	3.08

From the study, it can be stated that all of the aromatic rice germplasm have bands of the gene that influence the grain but they showed genetic variability. Information obtained from genotyping of varieties help to analyze the genetic diversity within and among closely related landraces which has the potential for crop improvement and to meet the diverse goals like producing cultivars with increased yield of aromatic rice.

3.4 PARTICIPATORY TECHNOLOGY VERIFICATION AND DISSEMINATION

3.4.1 Study of seed setting in hybrid maize seed production by using different male female ratios

Introduction:

Maize grain occupies a momentous position because of diversified use (food, feed, fodder, fuel and other raw materials for agro-based industries) in the world. The dietary changes, increase income, population growth rate in developing countries and the consequent growth in meat and poultry consumption have resulted rapid increase in the demand for maize grain for poultry, livestock feed and rwa materials for agro-based industries. The demand of maize grains is increasing for agro-based industries and about 46% maize grain imported from outside the country. The total amount of required hybrid seed was (2000-2500mt, Dawadi, 2015. personal communication) imported from India and other countries. Hybrid maize technology has made significant yield advantages and increased productivity dramatically in the world. This technology has revolutionized maize production in many countries (Vasal, 1998). Seed vision 2025 has given the high priority to develop and release the hybrids along with seed production of 3750mt. Till date seven Nepali hybrids have been released/registered in Nepal but their F_1 seed is not produced in commercial scale. Commercialization of hybrids is possible, if there is strong collaboration between public and private institutions which ensures to establish seed marketing system in Nepal.

Objective:

•To identify the appropriate female:male ratio in hybrid maize production technology.
•To motivate the different stake holders towards hybrid seed production technology.
•To increase the source of income of farmers by producing hybrid seed.

Materials and methods

Before inception of the activities, one day orientation program was organized. Participants were invited from agriculture cooperatives, farmers groups, maize super zone etc. The main objective was to explain the methodologies and role of different actors to implement the activities. Experiment was conducted in collaboration to farmers groups and Priminister Agriculture Modernization Project (PMAMP), Dang district. Maize hybrid seed production site (Deukhuri) was selected based on advice of PMAMP. Hybrid seed production verification trials were conducted in winter season, 2077. Eight farmers were selected to conduct trials. Distant isolation of 200m was maintained between the fields. Trial was conducted in two replications. Four farmers as a one replication and each farmers as a treatment. Plot size was varied based on female: male

ratios (2:1, 3:1, 4:1 4:2, 6:2 and 8:2). Seeding was done in rows with spacing of 60 cm in rows and seed to seed 25 cm for female and 22cm for male. Male rows seeded 3 days before seeding to female rows. All female rows were seeded after 3 days of male planting. In case of two male rows staggered planting (2 days interval) was followed. Recommended dose of chemical fertilizer was 120:60:40kg N:P:K kg/ha and compost/FYM was 10t/ha. All DAP and MOP was used as basal dose and urea was used in two split doses during knee height stage and just before tasseling stage. Male rows and female rows were marked with red and green pegs respectively. Farmers were trained for rouging and detasseling in female rows. Rouging was done at knee heigh stage and just before tasseling and silking. Detasseling in female rows was practiced just before anthesis. All the tassel were removed (detasseling) from female rows before pollen shedding. Every day careful detasseling was done to maintain genetic purity of seed. After the end of anthesis, all male rows were removed. Female rows were harvested when black layer was seen at the tip of grains. Grain yield was recorded from net harvested area and converted in to kg/ha by using the following formula.

Grain yield kg/ha= Field weight (kg) *10000*(100-GMC)*0.80/ Net harvested area*85

Results and discussion:

Among the tested ratios; 1:4 ratio produced highest seed yield of 2500kg/ha followed by 2:6 (1700kg/ha) and 1:3 (1650kg/ha). Poor grain yield was produced by other ratios could be the lower number of male rows, poor pollen production and poor synchronization between male and female tasseling and silking. Another similar trial was conducted at Jute Research program, Itahari during spring seasonand reported that 1:4 ratio produced more than 3000kg/ha.

Table 19: Performance of different female:male raito in hybrid maize seed production, Deukhuri

Treat.no.	Female: Male	Male rows	Female rows	Grain yield kg/ha
1	1:2	8	14	1100
2	1:3	6	15	1600
3	1:4	5	16	2500
4	1:5	5	18	0.950
5	2:4	8	16	1500
6	2:6	8	18	1700
7	2:8	8	24	0.800

Large plot demonstration of Rampur hybrid-10, CAH17/15 and Khumal hybrid-2

Large plot demonstration trial was conducted in 1000 m^2 area at Neupaanetar and Thumpakhar, Sindhupaalchok district. It was conducted in collaboration with famers groups and Hariyali Seed Company. A total of four farmers demonstrated these hybrids of which two were from Neupanetar and two were from Thumpakhar. The main

objective was to demonstrate the performance of registered Nepali Ramur hybrid-10 and promising hybrid CAH1715 under farmer's field under their management condition. Demonstration was conducted as per farmer's practices. Crop cutting data was recorded from each location. Comparison was made with Khumal hybrid-2. Farmers preferred Rampur hybrid-10 which produced grain yield of 8280kg/ha followed by CAH17/15 (7860kg/ha) and Khumalhybrid-2 (6120kg/ha). Based on farmers feedback Rampur hybrid-10 is best performing hybrid maize in this location and they are interested to buy large quantity of seed for coming season.

4. TECHNOLOGY TRANSFER AND SERVICES

4.1 Services:

NSSTRC has been working in close association with crop breeding and national commodity programmes, private seed companies, agricultural cooperatives, seed production projects /programs and provides the seed testing and information services to respective seed stakeholders. Followings were the seed quality attributes tested in Central seed laboratory following ISTA 2011 rules and guidelines as well as norms developed by NSB. Seed analysis reports were provided to respective seed producers, seed companies, researchers and farming groups. A total of 238 seed samples were analyzed and reported, out of which 148 samples were service samples and 90 samples were research sample (Annex 8.1 and 8.2). Similarly, 171 samples of rice and maize were analysed in molecular laboratory. Thus a total of 409 samples were analysed in NSSTRC laboratory in F. Y. 2077/78. Seed testing services focused on:

- Analytical Purity Analysis, Moisture Content Test and Germination test (Routine Seed Test)
- Tetrazolium Salt Test, Vigor Test, Ageing Test, Cold Test, Field plot and biochemical and molecular marker test (special testing)
- Proficiency seed sample testing

4.2 Publications:

In 2077/78, four publications were prepared, of which one is "Annual Report, 2077/78", leaflet entitled on "National Seed Science and Technology Research Center" in English and "*Rastriya Biu Bigyan Prabidhi Anusandhan Kendra- Eak Chinari*" in Nepali and *"Barnasankar Makaiko Biu Utpadan Prabidhi"* in Nepali language in order to disseminate the latest technological output and status of National Seed Science Technology Research Centre. (Annex 9).

4.3 Visits:

Due to COVID 19, groups from different stakeholders were not allowed to visit office but Scientists, Professors, Technicians, Students etc. were visited to have technical information and facilities of NSSTRC with regard to the seed quality testing services individually. Students, agriculture extension staffs of DoA, also visited the NSSTRC laboratory (Annex 10). Similarly, three international graduates were working as interns in NSSTRC, Khumaltar, Lalitpur in F.Y. 2077/78 and successfully completed their internship (Annex 11). Likewise, in F.Y. 2077/78, there was not any formal training program but on the spot training was provided to the farmers groups and seed producer cooperatives in Neupanetar and Thumpokhara of Sindhulalchowk district (Annex 7).

5. BUDGETAND EXPENDITURE

Total NSSTRC project and office administration cost for the year approved and released was NRs 1,42,59,000. Out of total budget, only NRs 1,25,76,017 was expended (Annex 12). During the year, total revenue of NRs 70,707.14 was collected through seed testing services and sales of research crop production and others (Annex 13). Total beruju was NRs 84,225 during 2076/77 which was sent for clearing process (Annex 14).

6. KEY PROBLEMS

Limited laboratory space is still the key problem in the centre. The centre has been successful in facilitating and strengthening the service and research resources with support of collaborative seed projects. Due to the limitation of space in the building they could not have been brought into full operation. For the limitation of the space, NSSTRC would suggest to allocate whole building and premises for NSSTRC as 'Seed Bhawan'. Another important problem is lack of scientific manpower to run the molecular lab and seed lab.

7. WAY FORWARD

A good amount of research in the field of National Seed Science Technology Research Centre has been carried out and significant contributions made on seed regulatory frameworks formulation and implementation in past and recent year by the centre. The field is wide as it includes a cadre of disciplines of seed biology to its marketing, management and uses. But in the present context following research areas on quality seeds for improving the production per unit area are felt to prioritize and carry out the studies:

- Basic studies on seed biology, morphology, and physiology of different agricultural crop species.
- Resiliency of seeds to climate change
- On-farm seed management and improvement of farmers saved seeds which dominates the national seed system
- Use of biotechnology and molecular techniques in support of seed technology and genetic studies of local crop diversity
- Collaborative research with different seed stakeholders
- Harmonizing the seed quality and their use
- Seed production research in hybrid maize and rice

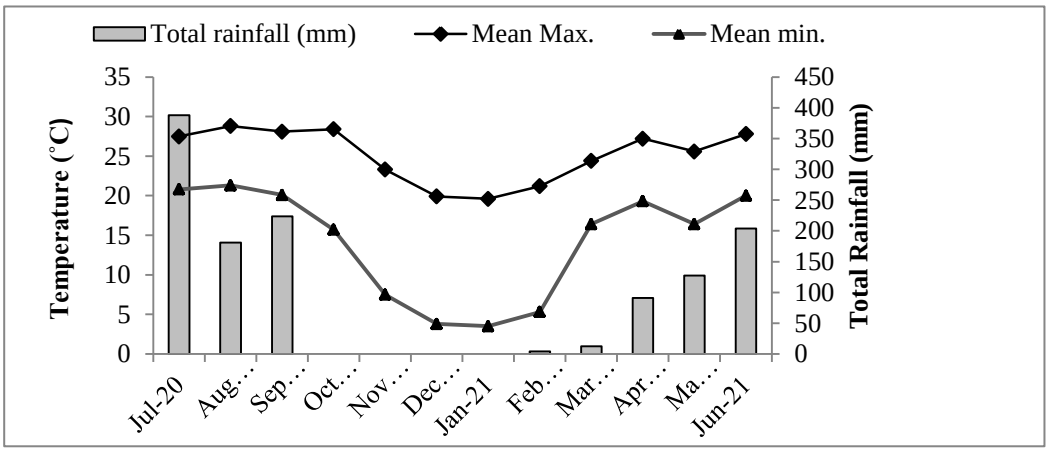
ANNEXES

Annex 1. Map of the seed production stations, NARC

Metrological information:

During this fiscal year, Khumaltar received 1231.09 mm annual rainfall in 115 rainy days with annual average of maximum and minimum temperature 25.15^{o}C and 14.17^{o}C respectively. Details are given in table .

Annex 2. Monthly agro-meteorological data, Khumaltar, 2077/78 (2020/21)

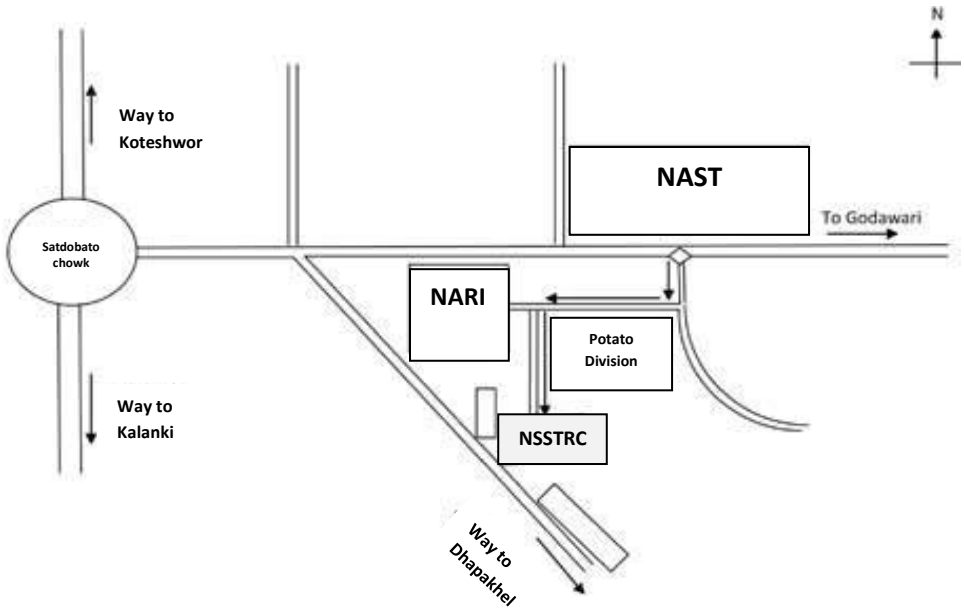


Maximum, minimum temperature and total monthly rainfall, Khumaltar, 2077/78 (2020/21)

Monthly agro-meteorological data, Khumaltar, Lalitpur, 2077/78 (2020/21)

Month/Year	Mean Temperature (°C)		Total rainfall (mm)	Rainy days (No.)
	Maximum	Minimum		
July	27.5	20.8	388.0	22
August	28.8	21.3	181.2	23
September	28.1	20.1	223.5	16
October	28.4	15.7	0.0	0.0
November	23.3	7.5	0.0	0.0
December	19.9	3.8	0.0	0.0
January	19.6	3.5	0.0	0.0
February	21.2	5.3	4.4	2.0
March	24.4	16.4	12.3	5.0
April	27.2	19.3	90.9	7.0
May	25.6	16.4	127.6	16
June	27.8	20	204	24
Mean/Total	**25.15**	**14.17**	**1231.9**	**115**

Annex 3. Map of the office/station



Annex 4.1. List of equipments/machines in seed testing laboratory facilities, 2077/78 (2020/21)

S.N.	Major instruments	Testing facilities
1	Ag seed magnifier *(W/light seed, Buro Ag-MC110/c)*	Magnifying seed
2	Air conditioner *(Chunlan)*	Maintaining temperature inside working room
3	Altimeter *(Multi-function digital altimeter, Model no. ZD-2028/ 6 in 1)*	Recording altitude of location during seed sampling
4	Balance *(Electric balance, Triple beam balance, Pan balance, Torsion balance, Digital counting balance/ Weighing scale, Electronic kitchen scale, Denver instrument-counting balance, 4-digit balance-Kern ABJ, 3-digit balance, Electronic balance of 100 kg capacity)*	Working sample preparation and seed weighing
5	Camera canon DSLR	Capturing photos of lab and field activities
6	Canon 3010 *(3 in 1 printer)*	Printing reports and protocols
7	Check point of O_2/Co_2 recharge adapter	Measuring O_2 and CO_2 of sample
8	Chlorophyll meter *(TYS-A and spad 502)*	Recording chlorophyll content of leaf
9	Computerized seed counter	Seed counting
10	Corn Thresher *(electric)*	Threshing corn
11	Dan sensor O_2 and CO_2 gas analyzer	Gas analysis
12	Desiccators *(Big size, medium size and small size)*	Sample storage for short period
13	Desktop Computer sets *(Goldkist, Lenovo, Acer)*	Data recording and technical works
14	Dickey John *(Grain Analyser Computerised Moisture Meter)*	Recording Moisture content of sample
15	Digital Calliper	Seed measurement unit (mm)
16	Digital Camera *(Canon, Sony, Cyber-shot 14.1 mega pixels, Carl Zeiss, Vario-Tessar)*	Capturing laboratory activities
17	Digital temperature and RH indicator	Recording Temperature and RH
18	Digital thermo hygrometer	Temperature and RH reading
19	Digital vernier caliper DL.S1 Lutron	Quantitative trait reading
20	Divider *(Boerner Seed Divider, Soil Seed Divider, Gamet Seed Divider)*	Working sample preparation
21	E.Q.F Disintegrator high speed mill *(24000 RPM, 100 GFW100)*	Seed milling
22	Eye piece-digital camera (*Coslab- MDCE-5C)*	Microscopic photography
23	Fax machine	Faxing documents
24	Fiber Measuring tape *(Field tape)*	Recording measurements of field
25	Filing cabinet *(steel and glass door cabinets)*	Record filing
26	Gas Air Quality Meter *(CO_2, O_2, CO, RH, 42 Temp 6 in 1)*	Gas analysis meter
27	Glass plate	Purity analysis
28	GPS- *GARMIN (e-Trex Legend H & Vista H, Rugged and high sensitivity GPS)*	Measurement of altitudes and others
29	Grain density meter *(Phoenix instrument)*	Weighing sample
30	Hand scoop SS large	Withdrawing samples
31	Hanna EC meter *(meters for EC/ TDS/OC/OF)*	Conductivity test
32	High Speed Grinder	Grinding sample
33	Hygrometer *(Tem./Clock/Humidity)*	RH /T measurement

S.N.	Major instruments	Testing facilities
34	Laboratory aspirator	Purity
35	Laptops *(Acer, Lenovo, Dell, slim laptop - dell)*	Data recording, analysis and report writing
36	Microscope *(Leitz-HM-LUX-3, Wild M3Z- Heerbrugs Switzerland, Olympus SZ51, Leitz-Laborluz K)*	Seed identification and seed micro-organism infection
37	Mini Tiller	Ploughing the research field
38	Mobile set *(Huawei and Redmi)*	Communicating devices
39	Oven *(Memmert (small and big), Electric Baking Oven)*	Moisture testing and drying beads
40	Paddy Thresher Machine *(Manual)*	Threshing rice
41	pH meter *(Portable)*	Recording pH of sample
42	Photocopy machine *(Canon-iR 1024)*	Photocopy and scanner
43	Plant growth chamber	Germination
44	Portable leaf area meter	Recording leaf area
45	Portable Sieve Set	Sieving
46	Projector *(Optima)*	Presentation of files
47	Refrigerator *(lg)*	Storing chemicals and reagents
48	Sample Trier set	Sampling unit
49	Samsung Tab A 8.0	Recording data and sharing information
50	Sealing Machine *(Vacuum sealer & Impulse sealer)*	Relative to post- harvest study
51	Seed ageing chamber *(10 cu ft. All stainless steel accumax India)*	Vigor test
52	Seed Aging Chamber	Vigor test
53	Seed analyzer with scanner	Seed analysis
54	Seed blower Dacota type	Blowing samples
55	Seed coating machine	Sample coating
56	Seed Enlarger seed Buro	Magnifying objects
57	Seed Germinator *(Labline Technocracy, Indosaw, Accumax)*	Germination of sample
58	Seed Grinder *(Rico and Victor)*	Seed moisture content
59	Seed grinder Lab mill *(3310 perten S/N 160611)*	Seed grinding
60	Seed Moisture Meter Wile 78 Crusher-7	Moisture test
61	Seed Purity Board	Seed purity
62	Seed sampler *(30 inches X 5 holes)*	Seed sampling
63	Seed sampling tier *(20 mm brass, light and heavy)*	Seed sampling
64	Seed scoop	Seed lifting
65	Sieve set (*B.B. Allauf mfg.co.inc. Washington D.C, 75mm / 20 sieves set)*	Sampling unit
66	Single ear thresher	Threshing
67	Single panicle/headthresher-1	Threshing
68	Soil Auger *(Screw type-98 mm)*	Soil sampler
69	Soil moisture meter	Soil moisture test
70	Stabilizer and Voltage Regulator *(Stavol-matsunaga, Powertech- 3KVA, Powertech-2 KVA, Premier Servo motor control PS 2000 VA and 1500VA)*	Power supply to sensitive machinery and digital balance
71	Steel cupboard *(plain and locker type)*	Storing record files and registers
72	The pHep Family Hanna Instrument *(Min./Max. temp*.	Seed conductivity test

S.N.	Major instruments	Testing facilities
	record)	
73	Thermometer *(Manual)*	Calibration of germinators
74	UPS *(Sukam, Emerson)*	Backup for computer
75	Vacuum seed counter	Seed counting
76	Water pump *(Crompton Greaves)*	Water supply
77	Wile-66	Portable grain moisture test
78	Xerox Canon MF 3010 set *(3 in one)*	Printing and scanning
79	ZH 3500 Generator	Power supply

Annex 4.2. Lists of equipments/machines in molecular laboratory facilities, 2077/78 (2020/21)

S.N.	Major Instruments	Testing facilities
1	Air Conditioner *(Panasonic)*	Cooling lab
2	Animax Real Time PCR *(PC system, Power backup solar Hybrid - 3 pieces)*	DNA Finger printing and backup system
3	Autoclave *(Accumax, India)*	Sterilization unit
4	Centrifuge *(REMI, CAT No. R-24, Serial no.-VCDP-5338)*	Homogenizing unit
5	Deep fridge *(Whirlpool and Yasuda)*	Preserving the DNAs
6	Desktop Computer set *(HP Pavilion and Acer)*	Data entry and analysis
7	Electrophoresis *(power supply - Serial no.93086, EV 243, Made in Belgium and Multi sub midi set 10 X 10 cm*)	Supply of power and gel electrophoresis unit
8	Gel documentation *(Alpha Innotech)*	Documenting the banding of DNAs on gel
9	Ice box	Cooling DNA samples
10	Ice flack machine-*SIMAG*	For making Ice Flakes
11	Incubator Machine *(Water bath)-18X18X18)*	Incubation
12	Laminar flow	Health test
13	Liquid Nitrogen Refrri	Storing liquid nitrogen
14	Magnetic stirrer *(SONAR, CAT No. MS-1, Serial no. F0034910311)*	Shaking and mixing unit
15	Medifuge *(Heraeus Sepatech RPM X 1000)*	Homogenizing unit
16	Micro Oven *(lg- ECN.MS-2344BB/01, Serial no. 803TAUL 00070)*	Preparing gel
17	Micro-centrifuge *(PPW Med. Instrument, Model no. MPW-55, Ref no. 10055)*	Homogenizing unit
18	pH meter *(Chemi line, Digital PH meter with ATC CL-120*)	Determining PH
19	Polymerase Chain Reaction *(PCR - Corbet, Model no. CGL-96, Serial no. C-10081)*	DNA sequence amplification unit
20	Refrigerated micro centrifuge *(Model T 50)*	Homogenizing unit
21	Spectrophotometer *(JENWAY, Model no. 6705, Serial no. 3651-single cell holder)*	Quantification of DNAs
22	Vaccine carrier *(1.6 liter w/4 Ice packs Aov)*	Cooling

S.N.	Major Instruments	Testing facilities
23	Vitascope *(Burrows equipment co., Evanston, Illionis, USA, Serial no. S104)*	X-rays of seed and Florets
24	Vortex mixer *(Accumax- Touch type and Tallboys USA-digital)*	Shaking the solns
25	Water bath *(SONAR)*	Warming the PCR Recipes
26	Water Distillation Unit *(Single distillation unit-accumax and Double distillation unit-biobase)*	Making distilled water

Annex 5. Human resource, 2077/78 (2020/21)

S. No.	Name	Position	Qualification	Specialization/ Working area
1	Narayan Bahadur Dhami	S_3	M Sc. Ag.	Plant breeding and genetics
2	Arjun Prakash Poudel	S_1	M Sc. Ag.	Agronomy
3	Sangita Kaduwal	S_1	M Sc. Ag.	Agronomy
4	Bisesh Rijal	T_5	B Sc. Ag.	Agronomy
5	Indira Devi Uprety	A_6	B.A.	Sociology
6	Supretee Manandhar Karmacharya	A_6	BBS	Account
7	Goma Bajgain	Technical Assistant (5th Level)	Literate	Lab Assistant
8	Bishnu Maharjan	Technical Assistant	Literate	Lab Assistant
9	Lahani Tharuni	Technical Assistant	Literate	Lab Assistant
10	Madan Man Dangol	Driver	Literate	Driving

Annex 6. Summary progress of research projects, 2077/78 (2020/21)

S. No.	Project/Activities	Annual budget in NRs. '000'	Progress	Remarks
1	**Micronutrient Seed Coating and Post-harvest Management Technology Generation in Field Crops.**	**573**		
1.1	Survey on micronutrient use in cropping pattern in mid hills and terai in Nepal.		Survey completed and data evaluation completed	
1.2	Assessment of polymer zinc and boron seed coating in wheat in hills		Significant difference in days to 50 % emergence was observed in wheat seeds coated with zinc and boron polymer.	
1.3	Effect of micronutrient seed coating in maize-wheat cropping system in mid hills		Significant difference in traits like days to 50% emergence, days to 50% heading and days to 80% maturity was observed in wheat seeds coated with micronutrients like Zinc sulphate, Borax, sodium	

S. No.	Project/Activities	Annual budget in NRs. '000'	Progress	Remarks
			molybdate, Ferrous sulphate.	
1.4	Assessment of polymer Zinc and Boron Seed Coating in wheat in terai		There is no significant difference observed in quantatitive traits. Further verification will be done.	
1.5	Effect of micronutrient seed coating in Rice-wheat cropping system of terai Nepal		Signicicant difference observed in traits like 1000 grain weight, grain yield and biomass yield in treatment of RBF NPK+ ZnSo4 @2 gm+ sodium molybdate @ 0.5 gm+ ferrous sulphate @ 0.5 gm/kg seed.	
2	**Qualitative and Quantitative Characterization of Pre-release Varieties of Agricultural crops**	**580**		
2.1	Agro-morphological characteristics study of hill varieties of rice		Descriptors of seven mid hill rice genotypes (NR-11115, NR-11105, NR-10676, NR-11375, NR11374, IR08FAN10 and standard check Khumal-4 prepared.	
2.2	Agro-morphological characteristics study of wheat genotypes, Khumaltar		Descriptors of eleven promising wheat genotypes namely WK-3167, WK-2843, WK-2787, WK 3005, WK 2891, WK-3166, WK-3163, WK-2820, Chyakhura, WK 3165 and WK-3164 and check varietyWK-1204, prepared.	
2.3	Agro-morphological characteristics study of promising finger millet genotypes		Descriptors of eight fingermillet genotypes/varieties namely; Dalle-1, Okhle-1, KLE-159, Kabre Kodo-1, Sailung Kodo-1, KLE-236, KLE-158 and Kabre Kodo-2 prepared.	
2.4	Agro-morphological characteristics study of promising buckwheat genotypes		Descriptors of eight promising buckwheat genotypes namely; ACC#5671, ACC#9251, ACC#2194, ACC#2223-1, ACC#2213, ACC#227-1, ACC#6506, Kabre bitter and check variety Mithe phapar-1 prepared.	
3	**Seed Variety Identification and Diversity Analysis using DNA Fingerpringting Technology**	**838**		
3.1	Genetic diversity analysis of different maize inbred lines using Simple Sequence Repeat (SSR) markers.		DNA finger prints of 25 maize inbred lines prepared.	
3.2	DNA fingerprinting and genetic diversity		DNA finger prints of 95	

S. No.	Project/Activities	Annual budget in NRs. '000'	Progress	Remarks
	analysis of different varieties of Aromatic Rice using Simple Sequence Repeat (SSR) markers.		aromatic rice landraces prepared.	
4	**Participatory Technology Verification and Dissemination on Quality Seed Production**	**644**		
4.1	Study of seed setting in hybrid maize seed production by using different male female ratio.		Female and female ratio of 2:1, 3:1, 4:1, 5:1, 4:2, 6:2 and 2:8 were studied and 4:1 was best	
4.2	Large plot demonstration of Rampur hybrid-10, CAH17/15 and Khumal hybrid-2		Rampur hybrid-10 was found best with grain yield of 8280kg/ha followed by CAH17/15 (7860kg/ha) and Khumal hybrid-2 120kg/ha).	
5	**Farm management project (FMP)**	**1815**		
5.1	Monitoring and Evaluation		Maize hybrid seed production block of Namuna Yakakrit Sahakari Kheti Biu Utpadan Samuha, Maharani Jhoda, Jhapa. Wheat seed production block at NRRP, Hardinath, Dhanusa and Maize hybrid seed production block at ARS, Belachapi, Dhanusa. Similarly, hybrid maize seed production block of Lumbini Seed company were monitored.	
5.2	Seed testing and molecular lab support		SSR marker, Glass wares, Chemicals were purchased.	
5.3	Seed testing services to different stake holders		A total of 238 (148 service samples and 90 research samples were tested in seed testing laboratory)	Researchers/stake holders didn't submit sufficient samples.
5.4	Office and farm management		Sanitation and beautification works carried out throughout the year in office premises	

Annex 7. Training/workshop/seminar organized, 2077/78 (2020/21)

S. No.	Name of Training/ Workshop/ Seminar	Duration	Target group	Location	No. of participants
1	Hybrid Maize Seed Production Technology	1 days	Farmers group	Sindhupalchowk	20
2	Hybrid Maize Seed Production Technology	1 days	Seed Producer group	Sindhupalchowk	10

Annex 8.1. Service provided (routine sample), FY 2077/78 (2020/21)

S.N.	Lab No.	Name and Address of Sender	Kind	Variety	Sample Received	PURITY TEST (%)				GERMINATION TEST (%)					Moisture Test (%)	1000 Seed Wt. (gm)	Remarks
						Pure Seed	Other Crop seed	Weed Seed	Inert matter	Ger.	Abnor.	Fresh	Hard	Dead			
1	001	श्री नेपाल बीउ बिजन उत्पादन केन्द्र, टौखेल	Potato	TPS-7/67	4/11/2077	0.0	0.0	0.0	0.0	95	0	3	0	2	0	0	HS
2	002		Potato	TPS-7/67	4/14/2077	0.0	0.0	0.0	0.0	84	0	10	0	6	0	0	HS
3	003	श्री सिद्धि कृषि सहकारी संस्था लिमिटेड, भक्तपुर	Wheat	WK 1204	4/16/2077	99.9	0.0	0.0	0.1	87	4	0	0	9	12.7	0	CS
4	004		Wheat	WK 1204	4/16/2077	100.0	0.0	0.0	Trace	94	3	0	0	3	11.3	0	CS
5	005		Wheat	Chyakhura	4/16/2077	99.8	0.0	0.0	0.2	87	2	0	0	11	11.9	0	CS
6	006		Wheat	Chyakhura	4/16/2077	99.9	0.0	0.0	0.1	89	4	0	0	7	13.1	0	CS
7	007		Wheat	Chyakhura	4/16/2077	99.9	0.0	0	0.1	89	4	0	0	7	10.6	0	CS
8	008		Wheat	Munal	4/16/2077	99.9	0.0	0.0	0.2	73	2	0	0	25	13.6	0	CS
9	009		Wheat	WK 1204	4/16/2077	99.9	0.0	0.0	0.1	97	2	0	0	1	10.4	0	CS
10	010		Wheat	WK 1204	4/16/2077	99.9	0.0	0	0.1	94	2	0	0	4	11.6	0	CS
11	011		Wheat	WK 1204	4/16/2077	99.9	0	0	0.1	93	4	0	0	3	9.9	0	CS
12	012		Wheat	Munal	4/16/2077	99.9	0	0	0.1	89	1	0	0	10	11.5	0	CS
13	013		Wheat	Munal	4/16/2077	100.0	0.0	Trace	Trace	90	7	0	0	3	10.6	0	CS
14	014		Wheat	Munal	4/16/2077	100.0	0	0	Trace	88	2	0	0	10	12.6	0	CS
15	015		Wheat	Munal	4/16/2077	99.8	0	0.0	0.2	86	3	0	0	11	12.3	0	CS
16	016		Wheat	WK 1204	4/16/2077	99.8	0.0	0	0.2	92	3	0	0	5	10.3	0	CS
17	017		Wheat	Munal	4/16/2077	99.7	Trace	0	0.3	93	4	0	0	3	14.1	0	CS
18	018		Wheat	WK 1204	4/16/2077	99.9	0.0	0.0	0.1	89	6	0	0	5	12.3	0	CS
19	019		Wheat	WK 1204	4/16/2077	99.6	0	0	0.4	89	6	0	0	5	10.7	0	CS
20	020		Wheat	WK 1204	4/16/2077	99.5	0	Trace	0.4	87	9	0	0	4	11.8	0	CS
21	021		Wheat	Munal	4/16/2077	99.6	Trace	0	0.4	90	7	0	0	3	11.9	0	CS
22	022		Wheat	Not mentioned	4/16/2077	99.8	Trace	0	0.2	85	5	0	0	10	12.7	0	CS
23	023		Wheat	Not mentioned	4/16/2077	99.8	0	0	0.2	65	7	0	0	28	11	0	CS
24	024	श्री दलचोकी सामुदायिक विकास समिति, दलचोकी	Rapeseed	डुंडे	4/21/2077	99.7	0	0	0.3	87	3	3	0	7	10	0	IS
25	025		Rapeseed	गुजुमुज्जे	4/21/2077	99.8	0	0	0.2	85	2	7	0	6	9.7	0	IS
26	026	श्री कालिञ्चोक टि.पि.एस मूल तथा उन्नत बीउ उत्पादन उद्योग, दोलखा	Potato	TPS-7/67	4/21/2077	0	0	0	0	87	1	10	0	2	7	0	Lot 1- Old HS
27	027		Potato	TPS-7/67	4/21/2077	0	0	0	0	34	0	63	0	3	6.4	0	Lot 2- HS
28	028		Potato	TPS-7/67	4/21/2077	0	0	0	0	31	0	64	0	5	0	0	Lot 3- HS
29	029	श्री नालढुंगा कृषि तथा बीउ उत्पादन सहकारी सस्था लिमिटेड, दोलखा	Wheat	WK 1204	4/30/2077	0	0	0	0	93	4	0	0	3	0	0	IS
30	030		Wheat	Dhaulagiri	64770	0	0	0	0	93	5	0	0	2	0	0	IS
31	031		Wheat	Sworgdwari	4/30/2077	0	0	0	0	85	5	0	0	10	0	0	IS
32	032	गण्डिय बाली विज्ञान अनुसन्धान	Wheat	WK 1204	4/32/2077	0	0	0	0	90	5	0	0	5	11.3	0	BS

S.N.	Lab No.	Name and Address of Sender	Kind	Variety	Sample Received	PURITY TEST (%)				GERMINATION TEST (%)					Moisture Test (%)	1000 Seed Wt. (gm)	Remarks
						Pure Seed	Other Crop seed	Weed Seed	Inert matter	Ger.	Abnor.	Fresh	Hard	Dead			
		केन्द्र, खुमलटार															
33	033		Wheat	Sworgdwari	4/32/2077	0	0	0	0	88	4	0	0	8	11.1	0	FS
34	034		Wheat	WK 1204	4/32/2077	0	0	0	0	86	5	0	0	9	11.1	0	FS A
35	035		Wheat	WK 1204	4/32/2077	0	0	0	0	86	5	0	0	9	10.8	0	FS B
36	036		Wheat	Munal	4/32/2077	0	0	0	0	88	6	0	0	6	12	0	FS A
37	037		Wheat	Munal	4/32/2077	0	0	0	0	62	5	0	0	33	11.2	0	FS B
38	038		Wheat	Chyakhura	4/32/2077	0	0	0	0	91	5	0	0	4	10.6	0	FS
39	039	राष्ट्रिय चरन तथा घासेबाली अनुसन्धान कार्यकम खुमलटार	Oat	Kamdhenu	6/1/2077	100	0	Trace	Trace	98	0	0	0	2	9.2	0	FS 2
40	040		Oat	Kamdhenu	6/1/2077	100	0	Trace	Trace	97	1	0	0	2	10.2	0	FS 1
41	041		Oat	Netra	6/1/2077	99.8	0	0.1	0.1	88	2	0	0	10	10.6	0	FS 1
42	042		Oat	Netra	6/1/2077	99.9	0	Trace	0.1	99	1	0	0	0	9.8	0	FS 2
43	043		Vetch	Common vetch	6/1/2077	100	0	Trace	Trace	88	3	7	0	2	16.1	0	FS 1
44	044		Vetch	Common vetch	6/1/2077	99.9	0	0	0.1	89	1	8	0	2	12	0	FS 2
45	045		Rye grass	Dhundhe	6/1/2077	88.7	0	0	11.3	28	3	45	0	24	12.9	0	FS 1
46	046		Rye grass	Dhundhe	6/1/2077	95.7	0	0	4.3	10	69	0	0	21	13.4	0	FS 2
47	047		Oat	Amritdhara	6/1/2077	99.8	0	0.1	0.1	74	2	16	0	8	10.8	0	FS 1
48	048		Oat	Nandani	6/1/2077	99.5	0	0.4	0.1	99	0	1	0	0	11	0	FS 1
49	049		Oat	Nandani	6/1/2077	99.9	0	Trace	0.1	96	1	3	0	0	9.5	0	FS 2
50	050		Oat	Parbati	6/1/2077	99.9	0	0	0.1	87	4	0	0	9	10.6	0	FS 1
51	051		Oat	Parbati	6/1/2077	99.9	0	0	0.1	87	2	0	0	11	11	0	FS 2
52	052		Oat	Ganesh	6/1/2077	99.9	0	Trace	0.1	95	0	0	0	5	10.9	0	FS 1
53	053		Oat	Ganesh	6/1/2077	99.7	0	0	0.3	97	0	0	0	3	10	0	FS 2
54	054	राष्ट्रिय बाली प्रजनन तथा आनुवशिक अनुसन्धान केन्द्र, खुमलटार	Wheat	Chyakhura	6/5/2077	99.5	0	0	0.5	36	15	0	0	49	0	0	NS
55	055		Wheat	Munal	6/5/2077	99.9	0	0	0.1	4	5	0	0	91	0	0	NS
56	056		Wheat	WK 1204	6/5/2077	99.8	0	0	0.2	65	15	0	0	20	0	0	NS
57	057		Wheat	WK 1712	6/5/2077	99.7	0	Trace	0.3	91	3	0	0	6	0	0	NS
58	058		Wheat	WK 2123	6/5/2077	99.9	0	0	0.1	68	12	0	0	20	0	0	NS
59	059		Wheat	WK 2278	6/5/2077	99.5	0	0	0.5	63	6	0	0	31	0	0	NS
60	060		Wheat	WK 2286	6/5/2077	99.6	0	0	0.4	43	16	0	0	41	0	0	NS
61	061		Wheat	WK 2370	6/5/2077	99.9	0	0	0.1	53	16	0	0	31	0	0	NS
62	062		Wheat	WK 2414	6/5/2077	99.9	0	0	0.1	51	7	0	0	42	0	0	NS
63	063		Wheat	WK 2422	6/5/2077	99.9	0	0	0.1	73	6	0	0	21	0	0	NS
64	064		Wheat	WK 2430	6/5/2077	99.1	0	0	0.9	49	2	0	0	49	0	0	NS
65	065		Wheat	WK 2432	6/5/2077	99.6	0	Trace	0.4	34	6	0	0	60	0	0	NS
66	066		Wheat	WK 2748	6/5/2077	99.5	Trace	0	0.5	83	3	0	0	14	0	0	NS
67	067		Wheat	WK 2891	6/5/2077	99.9	0	0	0.1	94	2	0	0	4	0	0	NS
68	068		Wheat	WK 3026	6/5/2077	99.7	0	0	0.3	91	4	0	0	5	0	0	NS

S.N.	Lab No.	Name and Address of Sender	Kind	Variety	Sample Received	PURITY TEST (%)				GERMINATION TEST (%)					Moisture Test (%)	1000 Seed Wt. (gm)	Remarks
						Pure Seed	Other Crop seed	Weed Seed	Inert matter	Ger.	Abnor.	Fresh	Hard	Dead			
69	069		Wheat	WK 3027	6/5/2077	99.8	0	0	0.2	67	12	0	0	21	0	0	NS
70	070		Wheat	WK 3164	6/5/2077	99.8	0	0	0.2	34	7	0	0	59	0	0	NS
71	071		Wheat	WK 3165	6/5/2077	99.9	0	0	0.1	41	8	0	0	51	0	0	NS
72	072		Wheat	Chyakhura	6/5/2077	99.8	0	Trace	0.2	88	5	0	0	7	0	0	NS
73	073		Wheat	WK 1712	6/5/2077	99.8	0	0	0.2	98	1	0	0	1	0	0	NS
74	074		Wheat	WK 2123	6/5/2077	99.6	0	Trace	0.4	96	2	0	0	2	0	0	NS
75	075		Wheat	WK 2278	6/5/2077	99.8	0	0	0.2	65	10	0	0	25	0	0	NS
76	076		Wheat	WK 2370	6/5/2077	99.5	0	0	0.5	93	2	0	0	5	0	0	NS
77	077	नेपाल बीउ बिजन उत्पादन केन्द्र, टौखेल	Potato	TPS-7/67	6/18/2077	0	0	0	0	85	0	0	0	0	0	0	HS
78	078		Potato	TPS-7/67	6/18/2077	0	0	0	0	89	0	0	0	0	0	0	HS
79	079	एभरेष्ट सिड कम्पनी प्रा.लि, खुमलटार, ललितपुर	Wheat	Sworgdwari	6/23/2077	100	0	0	Trace	88	4	0	0	8	11.2	0	IS
80	080		Wheat	WK 1204	6/23/2077	100	0	Trace	Trace	96	1	0	0	3	1.5	0	IS
81	081		Wheat	Gautam	6/23/2077	100	0	Trace	Trace	86	6	0	0	8	11.4	0	IS
82	082	श्री नालढुंगा कृषि तथा बीउ उत्पादन सहकारी सस्था लिमिटेड, दोलखा	Maize	Ganesh 1	6/26/2077	0	0	0	0	86	7	0	0	7	0	0	IS
83	083		Maize	Rampur Composite	6/26/2077	0	0	0	0	95	2	0	0	3	0	0	IS
84	084		Maize	Manakamana 3	6/26/2077	0	0	0	0	69	3	4	0	24	0	0	IS
85	085	केन्द्रिय कृषि प्रयोगशाला, हरिहरभवन, ललितपुर	Wheat	WK 1204	7/16/2077	0	0	0	0	89	5	0	0	6	0	0	Lot 1
86	086		Wheat	Sworgdwari	7/16/2077	0	0	0	0	79	7	0	0	14	0	0	Lot 2
87	087		Wheat	Chyakhura	7/16/2077	0	0	0	0	88	6	0	0	6	0	0	Lot 3
88	088		Wheat	WK 1204	7/16/2077	0	0	0	0	85	8	0	0	7	0	0	Lot 1
89	089		Wheat	Sworgdwari	7/16/2077	0	0	0	0	81	7	0	0	12	0	0	Lot 2
90	090		Wheat	Chyakhura	7/16/2077	0	0	0	0	84	7	0	0	9	0	0	Lot 3
91	091		Wheat	WK 1204	7/16/2077	0	0	0	0	90	6	0	0	4	0	0	Lot 1
92	092		Wheat	Sworgdwari	7/16/2077	0	0	0	0	80	6	0	0	14	0	0	Lot 2
93	093		Wheat	Chyakhura	7/16/2077	0	0	0	0	85	6	0	0	9	0	0	Lot 3
94	094	प्रमिला कृषि फार्म, मूलपानी, काठमाण्डौं	Tomato	Srijana	7/20/2077	100	0	0	0	88	1	10	0	1	6.3	0	HS
95	095	चरन तथा घासेबाली अनुसन्धान कार्यकम, खुमलटार	Fodder	African Tall	8/14/2077	0	0	0	0	100	0	0	0	0	0	0	PhD sample
96	096		Fodder	J1006	8/14/2077	0	0	0	0	88	0	0	0	12	0	0	PhD sample
97	097		Fodder	Pratap Makka Chari 6	8/14/2077	0	0	0	0	75	0	13	0	12	0	0	PhD sample
98	098	नालढुंगा कृषि तथा बीउ उत्पादन सहकारी सस्था	Maize	Ganesh 1	9/15/2077	0	0	0	0	98	0	1	0	1	0	0	IS

S.N.	Lab No.	Name and Address of Sender	Kind	Variety	Sample Received	PURITY TEST (%)				GERMINATION TEST (%)					Moisture Test (%)	1000 Seed Wt. (gm)	Remarks
						Pure Seed	Other Crop seed	Weed Seed	Inert matter	Ger.	Abnor.	Fresh	Hard	Dead			
		लिमिटेड, दोलखा															
99	099		Maize	Rampur Composite	9/15/2077	0	0	0	0	95	2	2	0	1	0	0	IS
100	100	राष्ट्रिय बाली विज्ञान अनुसन्धान केन्द्र, खुमलटार	Rice	Khumal 10	9/29/2077	0	0	0	0	99	1	0	0	0	10.5	0	BS
101	101		Rice	Khumal 4	9/29/2077	0	0	0	0	95	1	3	0	1	10.4	0	FS
102	102		Rice	Khumal 8	9/29/2077	0	0	0	0	95	1	2	0	2	10.8	0	FS
103	103		Rice	Khumal 10	9/29/2077	0	0	0	0	97	2	1	0	0	10.7	0	FS
104	104		Rice	Khumal 11	9/29/2077	0	0	0	0	89	4	4	0	3	11	0	FS
105	105		Rice	Chainung 242	9/29/2077	0	0	0	0	91	3	3	0	3	10.9	0	FS
106	106		Rice	08 FAN 10	9/29/2077	0	0	0	0	94	1	3	0	2	11.4	0	FS
107	107		Rice	Khumal 4	9/29/2077	0	0	0	0	98	1	0	0	1	11.1	0	BS
108	108	श्री सिद्धि कृषि सहकारी संस्था लिमिटेड, भक्तपुर	Rice	Chainung 242	10/15/2077	98.9	0	0	1.1	87	7	2	0	4	13	0	CS
109	109		Rice	Chainung 242	10/15/2077	99.5	0	Trace	0.5	95	2	1	0	2	11.7	0	CS
110	110		Rice	Khumal 11	10/15/2077	99.6	0	0	0.4	93	4	0	0	3	12.1	0	CS
111	111		Rice	Chainung 242	10/15/2077	98.4	0	0	1.6	98	1	1	0	0	10.8	0	CS
112	112		Rice	Khumal 11	10/15/2077	99.9	0	0	0.1	88	5	2	0	5	13.9	0	CS
113	113		Rice	Chainung 242	10/15/2077	98.6	0	0	1.4	92	6	0	0	2	10.5	0	CS
114	114		Rice	Chainung 242	10/15/2077	96.5	0	0	3.5	90	2	2	0	6	13.8	0	CS
115	115		Rice	Khumal 10	10/15/2077	99.7	0	Trace	0.3	99	0	0	0	1	11.5	0	CS
116	116	राष्ट्रिय पशु आहारा तथा लाईभस्टक गू व्यवस्थापन प्रयोगशाला, हरिहरभवन	Fodder	Phurcha (Elymus spp.)	10/20/2077	72.6	0	0	27.4	32	0	10	0	58	16.3	0	IS
117	117	राष्ट्रिय बाली प्रजनन तथा आनुवांशिक अनुसन्धान केन्द्र, खुमलटार	Rice	Khumal 4	10/21/2077	99.9	0	0	0.1	97	0	2	0	1	0	0	BS
118	118		Rice	Khumal 8	10/21/2077	98.6	0.1	0	1.3	97	1	1	0	1	0	0	BS
119	119		Rice	Khumal 10	10/21/2077	98.8	0	0	1.3	98	1	1	0	0	0	0	BS
120	120		Rice	Khumal 11	10/21/2077	99.8	0	0	0.2	92	2	2	0	4	0	0	BS
121	121		Rice	Khumal 13	10/21/2077	99.9	0	0	0.1	94	1	2	0	3	0	0	BS
122	122		Rice	08 FAN 10	10/21/2077	99.6	0	0	0.4	95	0	2	0	3	0	0	BS
123	123		Rice	NR 10490	10/21/2077	99.3	0	0	0.7	96	1	0	0	3	0	0	BS
124	124		Rice	NR 10676	10/21/2077	99.1	0	0	0.9	97	1	1	0	1	0	0	BS
125	125		Rice	Chainung 242	10/21/2077	99.8	0	0	0.2	93	1	3	0	3	0	0	BS
126	126	राष्ट्रिय बाली प्रजनन तथा आनुवांशिक अनुसन्धान केन्द्र, खुमलटार	Maize	Manakamana 4	10/27/2077	0	0	0	0	100	0	0	0	0	0	0	BS
127	127		Maize	Khumal Hybrid 2	10/27/2077	0	0	0	0	99	0	0	0	1	0	0	HS
128	128	निर्मल कृषि सहकारी संस्था लिमिटेड, सिद्धिपुर	Rice	Chainung 242	11/23/2077	99.8	0	Trace	0.2	96	2	0	0	2	12.2	0	IS

S.N.	Lab No.	Name and Address of Sender	Kind	Variety	Sample Received	PURITY TEST (%)				GERMINATION TEST (%)					Moisture Test (%)	1000 Seed Wt. (gm)	Remarks
						Pure Seed	Other Crop seed	Weed Seed	Inert matter	Ger.	Abnor.	Fresh	Hard	Dead			
129	129		Rice	Chainung 242	11/23/2077	99.4	0	Trace	0.6	98	1	1	0	0	10.4	0	IS
130	130		Rice	Chainung 242	11/23/2077	99.6	0	0	0.4	97	1	0	0	2	11.6	0	IS
131	131		Rice	Chainung 242	11/23/2077	99.8	0	Trace	0.2	97	1	0	0	2	11.4	0	IS
132	132		Rice	Chainung 242	11/23/2077	99.6	0	0	0.4	98	0	1	0	1	12.8	0	IS
133	133	एभरेष्ट सिड कम्पनी प्रा.लि, खुमलटार, ललितपुर	Rice	Khumal 4	12/5/2077	99.9	0	0	0.1	95	3	1	0	1	10.4	0	IS
134	134		Rice	Khumal 10	12/5/2077	99.9	0	Trace	0.1	97	1	1	0	1	10.6	0	IS
135	135		Rice	Khumal 11	12/5/2077	99.9	0	Trace	0.1	98	0	1	0	1	10.1	0	IS
136	136		Rice	Chainung 242	12/5/2077	100	0	0	Trace	96	1	1	0	2	10	0	IS
137	137	नालढुंगा कृषि तथा बीउ उत्पादन सहकारी सस्था लिमिटेड, दोलखा	Rice	Khumal 13	12/10/2077	0	0	0	0	97	2	0	0	1	0	0	IS
138	138		Rice	Khumal 4	12/10/2077	0	0	0	0	86	9	3	0	2	0	0	IS
139	139		Rice	Khumal 10	12/10/2077	0	0	0	0	67	25	6	0	2	0	0	IS
140	140	श्री सिद्धि कृषि सहकारी संस्था लिमिटेड, भक्तपुर	Rice	Khumal 11	12/22/2077	98.3	0	Trace	1.7	96	1	1	0	2	13.2	0	IS
141	141		Rice	Khumal 11	12/22/2077	98.9	0	0	1.1	92	2	2	0	4	14.5	0	IS
142	142		Rice	Chainung 242	12/22/2077	99.4	0	0	0.6	96	1	1	0	2	12.8	0	IS
143	143		Rice	Khumal 11	12/22/2077	99.4	0		0.6	96	1	1	0	2	12.2	0	IS
144	144		Rice	Khumal 11	12/22/2077	99.1	0	Trace	0.8	93	2	2	0	3	11.8	0	IS
145	145		Rice	Khumal 10	12/22/2077	99.5	0	Trace	0.5	98	1	0	0	1	11.2	0	IS
146	146		Rice	Khumal 11	12/22/2077	99.8	0	0	0.2	99	0	1	0	0	11.6	0	IS
147	147		Rice	Khumal 11	12/22/2077	99.9	0	0	0.1	97	1	0	0	2	12.3	0	IS
148	148	राष्ट्रिय बाली विज्ञान अनुसन्धान केन्द्र, खुमलटार	Wheat	WK 1204	3/8/2078	0	0	0	0	35	19	0	0	46	8.5	0	FS

Annex 8.2. Service provided (research sample), FY 2077/78 (2020/21)

Lab No	Name and Address of Sender	Kind	Variety	Sample Received	GERMINATION TEST (%)	PURITY TEST (%)	MOISTURE TEST (%)	Remarks
R1	Kumar Mani Dahal /Srijan Pokherel	Okra	Arka Anamika	6/11/2077	100	100	11.2	Distilled water
R2		Okra	Arka Anamika	6/11/2077	85	0	0	5% Neem Leaf extract
R3		Okra	Arka Anamika	6/11/2077	75	0	0	5% banmara leaf extract
R4		Okra	Arka Anamika	6/11/2077	80	0	0	5% Asuro leaf extract
R5		Okra	Arka Anamika	6/11/2077	80	0	0	5% Bakaino leaf extract
R6		Okra	Arka Anamika	6/11/2077	85	0	0	5% Cow urine
R7		Okra	Arka Anamika	6/11/2077	5	0	0	25% Cow urine
R8		Okra	Arka Anamika	6/11/2077	100	0	0	Control
R9	हरियाली सामुदायिक बीउ विजन कम्पनी प्रा.लि, सिन्धुपाल्चोक	Maize	Ganesh 1	6/30/2077	98	100	12.3	Improved seed
R10		Maize	Deuti 1	6/30/2077	98	100	13	Improved seed
R11	देवीथान कृषि सहकारी संस्था लिमिटेड, दोलाखा	Maize	Not mentioned	7/2/2077	92	99.9	9.9	Improved seed
R12	National Maize Research Programme, Chitwan	Maize	RML 18	7/8/2077	70	0	0	
R13		Maize	RML 150	7/8/2077	97	0	0	
R14	National Agronomy Research Centre, Khumaltar	Wheat	WK 3026	8/18/2077	86	0	12.9	
R15	Gopal Bhandari-Seed Coating Sample	Wheat	Aditya	8/22/2077	96	0	0	T1
R16		Wheat	Aditya	8/22/2077	94	0	0	T2
R17		Wheat	Aditya	8/22/2077	86	0	0	T3
R18		Wheat	Aditya	8/22/2077	93	0	0	T4
R19		Wheat	Aditya	8/22/2077	92	0	0	T5
R20		Wheat	Aditya	8/22/2077	93	0	0	T6
R21		Wheat	Aditya	8/22/2077	87	0	0	T7
R22	Sangita Kaduwal-Seed Coating Sample	Wheat	WK 1204	8/24/2077	96	0	0	T1 KH-Activity 5-trial 6m2
R23		Wheat	WK 1204	8/24/2077	88	0	0	T2 KH
R24		Wheat	WK 1204	8/24/2077	88	0	0	T3 KH
R25		Wheat	WK 1204	8/24/2077	88	0	0	T4 KH
R26		Wheat	WK 1204	8/24/2077	86	0	0	T5 KH
R27		Wheat	WK 1204	8/24/2077	85	0	0	T6 KH
R28		Wheat	WK 1204	8/24/2077	89	0	0	T7 KH

Lab No	Name and Address of Sender	Kind	Variety	Sample Received	GERMINATION TEST (%)	PURITY TEST (%)	MOISTURE TEST (%)	Remarks
R29	Sangita Kaduwal-Seed Coating Sample	Wheat	WK 1204	8/24/2077	79	0	0	T1 KH-Activity 2 -trial 10 m2
R30		Wheat	WK 1204	8/24/2077	84	0	0	T2 KH
R31		Wheat	WK 1204	8/24/2077	76	0	0	T3 KH
R32		Wheat	WK 1204	8/24/2077	74	0	0	T4 KH
R33		Wheat	WK 1204	8/24/2077	84	0	0	T5 KH
R34		Wheat	WK 1204	8/24/2077	86	0	0	T6 KH
R35		Wheat	WK 1204	8/24/2077	83	0	0	T7 KH
R36		Wheat	WK 1204	8/24/2077	88	0	0	T8 KH
R37	Agromorphological characterization of Wheat field	Wheat	WK 3167	8/26/2077	71	0	0	T1
R38		Wheat	WK 1204	8/26/2077	97	0	0	T2
R39		Wheat	WK 2843	8/26/2077	90	0	0	T3
R40		Wheat	WK 2787	8/26/2077	83	0	0	T4
R41		Wheat	WK 3005	8/26/2077	93	0	0	T5
R42		Wheat	WK 2891	8/26/2077	98	0	0	T6
R43		Wheat	WK 3166	8/26/2077	83	0	0	T7
R44		Wheat	WK 3163	8/26/2077	87	0	0	T8
R45		Wheat	WK 2820	8/26/2077	85	0	0	T9
R46		Wheat	Chyakhura	8/26/2077	73	0	0	T10
R47		Wheat	WK 3165	8/26/2077	33	0	0	T11
R48		Wheat	WK 3164	8/26/2077	32	0	0	T12
R49	राष्ट्रिय चरन तथा धांसेबाली अनुसन्धान कार्यक्रम, खुमलटार	Fodder	J1006	9/22/2077	100	0	0	Not treated
R50		Fodder	Pratap Makka Chari 6	9/22/2077	25	0	0	Treated
R51		Fodder	J1006	9/22/2077	100	0	0	Not treated
R52		Fodder	Pratap Makka Chari 6	9/22/2077	38	0	0	Treated
R53	राष्ट्रिय चरन तथा धांसेबाली अनुसन्धान कार्यक्रम, खुमलटार	Fodder	Pratap Makka Chari 6	10/7/2077	38	0	0	PhD sample
R54	Sujaya Upreti - Research Sample	Maize	Arun 2	12/1/2077	95	0	0	PhD sample
R55	राष्ट्रिय कृषि आनुवांशिक श्रोत केन्द्र, खुमलटार	Rice	NGRC 3286	12/1/2077	0	0	0	cross check sample
R56		Rice	NGRC 3367	12/1/2077	5	0	0	cross check sample
R57		Buckwheat	C011484	12/1/2077	0	0	0	cross check sample

Lab No	Name and Address of Sender	Kind	Variety	Sample Received	GERMINATION TEST (%)	PURITY TEST (%)	MOISTURE TEST (%)	Remarks
R58		Fingermillet	C0-12936	12/1/2077	42	0	0	cross check sample
R59		Fingermillet	C0-10783	12/1/2077	0	0	0	cross check sample
R60		Coriander	C02274	12/1/2077	51	0	0	cross check sample
R61		Coriander	C010403	12/1/2077	67	0	0	cross check sample
R62		Sunflower	C10654	12/1/2077	0	0	0	cross check sample
R63		Sorghum	C010722	12/1/2077	1	0	0	cross check sample
R64		Amaranths	C010145	12/1/2077	3	0	0	cross check sample
R65		Amaranths	C010259	12/1/2077	23	0	0	cross check sample
R66		Brinjal	C 3341	12/1/2077	47	0	0	cross check sample
R67		Brinjal	C03036 B	12/1/2077	24	0	0	cross check sample
R68		Niger	C0-12822	12/1/2077	0	0	0	cross check sample
R69		Perilla	C010455	12/1/2077	0	0	0	cross check sample
R70		Perilla	C0-12956	12/1/2077	0	0	0	cross check sample
R71		Funnel	C06298	12/1/2077	42	0	0	cross check sample
R72	केन्द्रिय कृषि प्रयोगशाला, हरिहरभवन, ललितपुर	Radish	Mino Early	12/24/2077	0	0		Proficiency sample
R73		Radish	40 days	12/24/2077	0	0	5.9	Proficiency sample
R74		Radish	Tokinasi	12/24/2077	0	0	8.1	Proficiency sample
R75		Radish	Mino Early	12/24/2077	0	0	6.2	Proficiency sample
R76		Radish	40 days	12/24/2077	0	0	6	Proficiency sample
R77		Radish	Tokinasi	12/24/2077	0	0	8.3	Proficiency sample
R78	चरन तथा घांसेवाली अनुसन्धान केन्द्र, रसुवा	Grass	Baji	1/7/2078	0	0	0	Moldy sample and fungi infected
R79		Grass	Teosinte	1/7/2078	0	0	0	
R80		Grass	Parbati	1/7/2078	0	0	0	
R81		Grass	Vetch	1/7/2078	0	0	0	
R82		Grass	Red clover	1/7/2078	0	0	0	
R83		Grass	White clover	1/7/2078	0	0	0	
R84		Grass	Rye, Dhunchee	1/7/2078	0	0	0	
R85		Grass	Rye, Kakasfat	1/7/2078	0	0	0	
R86		Grass	Rye, Red falcom	1/7/2078	0	0	0	
R87	National Seed Science Technology Research Centre, Khumaltar	Maize	Not mentioned	1/26/2078	97	0	0	
R88		Maize	Not mentioned	1/26/2078	96	0	0	

Lab No	Name and Address of Sender	Kind	Variety	Sample Received	GERMINATION TEST (%)	PURITY TEST (%)	MOISTURE TEST (%)	Remarks
R89	National Seed Science Technology Research Centre, Khumaltar	Rice	Khumal 10	2/20/2078	98	0	0	
R90	National Seed Science Technology Research Centre, Khumaltar	Rice	Sabitri	3/7/2078	86	0	0	Foundation

Note: DoLS=Department of Livestock Services, JJGBFPPNU=Jana Jyoti Ghas Bue Falfull Pashu Palan Nursary Udyog, NSPC=Nepal Seed Production Center, AD=Agronomy Division, DCDC=Dalchoki Community Development Committee, NWRP=National Wheat Research Programme, PKF=Pramila Krishi Farm, HRS=Horticulture Research Station, SKTPS& IPI=Shree Kalinchowk TPS & Improved Seed Production Industry, SKSS Ltd.=Siddhi Krishi Sahakari Sanstha Limited, NKSPSS Ltd=Naldhunga Krishi and Seed Production Sahakari Sanstha Limited, RARS=Regional Agricultural Research Station, ARS=Agricultural Research Station, ABD=Agriculture Botany Division, SQCC=Seed Quality Control Centre, RS=Ranjitpur Sample, Nepalgunj sample, PS=Proficiency Sample, BS=Breeder Seed, SKSS Ltd= Siddhi Krishi Sahakari Sanstha Limited, Bhaktapur, FS=Foundation Seed, CS=Certified Seed, IS=Improved Seed, HS=Hybrid Seed.

Annex 9. Publications, 2077/78 (2020/21)

S. No.	Name of publications	Type *	Language	Authors	No. of copies
1	Annual Report (2076/77)	Book	English	NSSTRC	100
2	National Seed Science Technology Research Center	Leaflet	English	NSSTRC	500
3	राष्ट्रिय बीउ बिज्ञान प्रबिधि अनुसन्धान केन्द्र- एक चिनारी	Leaflet	Nepali	NSSTRC	500
4	बर्णशंकर मकैको बीउ उत्पादन प्रबिधि	Booklet	Nepali	श्री नारायण ब. धामी	100

**Books, leaflet, brochure, manuals, pamphlets, audio visual etc*

Annex 10. Visit of the office by farmers, extension officials/technicians, entrepreneurs, cooperatives, farmer groups, NGO/CBOs officials etc.

S.No.	Leader's name	Students Number	Area of Major Interest
1	None	None	None

Annex 11. Work experience programme (WEP), internship and volunteers, 2077/78 (2020/21)

S. o.	Name of students	Qualification	Name of college/University	Mobile no.
1	Prabin Dawadee	M.Sc. Ag. (Agronomy)	Chandra Shekhar Azad University of Agriculture & Technology	9813190167
2	Buddhini Kiriwaththuduwa	MPhil-Plant Breeding & Molecular Biology	University of Colombo	9840916567
3	Mohan Kumar Pun Magar	B. Sc. Ag.	Amritsar College of Engineering & Technology (ACET)	9806264777

Annex 12. नियमित तर्फको बार्षिक बजेट र खर्चको विवरण आ. ब. २०७७/७८ (२०२०/२१)

चालु खर्च बजेट खर्च उप शिर्षक: ३१२४११०१३

खर्च/ वित्तीय सङ्केत नं	खर्च/वित्तीय सङ्केतको नाम	अन्तिम बजेट	प्रथम चौमासिक खर्च	दोश्रो चौमासिक खर्च	तेश्रो चौमासिक खर्च	वार्षिक खर्च	बाँकी बजेट
२११११	पारिश्रमिक कर्मचारी	५,५०३,०००	१,५७७,३८७.२०	१,४२३,४५६.४०	१,६५०,४०६.७०	४,६५१,२५०.३०	८५१,७४९.७०
२११२१	पोशाक	२००,०००	०	०	१०००००	१००,०००.००	१००,०००.००
२११३२	महंगी भत्ता	२७५,०००	६६,०००.००	७०,०००.००	८०,०००.००	२१६,०००.००	५९,०००.००
२१२१३	योगदानमा आधारित बीमा	५३,०००	१३,२००.००	१३,२००.००	१६,८००.००	४३,२००.००	९,८००.००
	उपभोग खर्च	**६,०३१,०००**	**१,६५६,५८७.२०**	**१,५०६,६५६.४०**	**१,८४७,२०६.७०**	**५,०१०,४५०.३०**	**१,०२०,५४९.७०**
२२२१२	इन्धन (कार्यालय प्रयोजन)	४३९,०००	३५,८६४.००	१५६,८५८.००	२४५,२००.३४	४३७,९२२.३४	१,०७७.६६
२२५२१	उत्पादन सामग्री / सेवा खर्च	३,०९७,०००	१,१२६,१६३.००	८०५,४८८.२०	१,०३३,५६०.१०	२,९६५,२११.३०	१३१,७८८.७०
२२६११	अनुगमन, मूल्यांकन खर्च	१३४,०००	०	३०००	१२२१००	१२५,१००.००	८,९००.००
२२६१२	भ्रमण खर्च	७८०,०००	१२८,८७५.००	३०७,५४५.००	१८२,१८५.००	६१८,६०५.००	१६१,३९५.००
	कार्यक्रम खर्च	**४,४५०,०००**	**१,२९०,९०२.००**	**१,२७२,८९१.२०**	**१,५८३,०४५.४४**	**४,१४६,८३८.६४**	**३०३,१६१.३६**
२२१११	पानी तथा बिजुली	१००,०००	७,८५८.००	२०,७५१.००	१९,०९७.००	४७,७०६.००	५२,२९४.००
२२११२	संचार महसुल	१००,०००	१६,५५०.००	२,५००.००	६५,५९५.००	८४,६४५.००	१५,३५५.००
२२२१३	सवारी साधन मर्मत खर्च	३२०,०००	४९,६४६.००	७९,९३८.००	१७६,१६७.६५	३०५,७५१.६५	१४,२४८.३५
२२२१४	बिमा तथा नवीकरण खर्च	५०,०००	३०,४५०.००	०.००	०.००	३०,४५०.००	१९,५५०.००
२२२२१	मेशिनरी तथा औजार मर्मत	२५१,०००	०	०	२०६९९९	२०६,९९९.००	४४,००१.००
२२२३१	निर्मित सार्वजनिक सम्पत्तिको	१६४,०००	०	०	१६२६२४	१६२,६२४.४२	१,३७५.५८
२२२९१	अन्य सम्पत्तिहरूको संचालन	३३,०००	४,८५०.००	८,८७०.००	१८,४९९.२३	३२,२१९.२३	७८०.७७
२२३११	मसलन्द तथा कार्यालय सामाग्री	२९३,०००	१३१,६८६.००	८७,६३७.००	६,४४१.००	२२५,७६४.००	६७,२३६.००
२२३१४	इन्धन - अन्य प्रयोजन	८४,०००	०	२८२०	४११०५	४३,९२५.००	४०,०७५.००
२२३१५	पत्रपत्रिका, छपाई तथा सूचना प्र	१६६,०००	६७,१३२.००	०.००	९८,५८५.००	१६५,७१७.००	२८३.००
२२४१२	सूचना प्रणाली तथा सफ्टवेयर सं.	१००,०००	०	०	६७५०६	६७,५०६.००	३२,४९४.००

खर्च/ वित्तीय सङ्केत नं	खर्च/वित्तीय सङ्केतको नाम	अन्तिम बजेट	प्रथम चौमासिक खर्च	दोश्रो चौमासिक खर्च	तेश्रो चौमासिक खर्च	वार्षिक खर्च	बाँकी बजेट
२२७११	विविध खर्च	९०,०००	२९,९४५.००	१८,६००.००	४०,६२०.००	८९,१६५.००	८३५.००
	प्रशासनिक खर्च	**१,७५१,०००**	**३३८,११७.००**	**२२१,११६.००**	**९०३,२३९.३०**	**१,४६२,४७२.३०**	**२८८,५२७.७०**
	कुल जम्मा	**१२,२३२,०००**	**३,२८५,६०६.२०**	**३,०००,६६३.६०**	**४,३३३,४९१.४४**	**१०,६१९,७६१.२४**	**१,६१२,२३८.७६**

पूजीगत खर्च बजेट खर्च उप शिर्षक: ३१२४११०१४

खर्च/वित्तीय सङ्केत नं	खर्च/वित्तीय सङ्केतको नाम	अन्तिम बजेट	प्रथम चौमासिक खर्च	दोश्रो चौमासिक खर्च	तेश्रो चौमासिक खर्च	वार्षिक खर्च	बाँकी बजेट
३११२२	Refrigerator	५६,०००.००	०	०.००	५५९३५.००	५५९३५.००	६५.००
३११२२	Dehumidifier	१४०,०००.००	०	०.००	९६०५०.००	९६०५०.००	४३९५०.००
३११२२	प्रीन्टर खरिद	३५,०००.००	३४,७००.००	०.००	०.००	३४७००.००	३००.००
३११२२	Air Conditioner	१४०,०००.००	०	०.००	१३३३४०.००	१३३३४०.००	६६६०.००
३११२२	ल्यापटप खरिद	५६,०००.००	५५,७९९.००	०.००	०.००	५५७९९.००	२०१.००
३११२३	फर्निचर खरिद	५०,०००.००	०	४५३१३.००	४६८७.००	५००००.००	०.००
३११२३	अफिसर्स कुर्ची	१००,०००.००	०	५५३७०.००	४४१३३.४८	९९५०३.४८	४९६.५२
३११२३	दराज खरिद	५०,०००.००	०	३०५१०.००	१९४९०.००	५००००.००	०.००
३११३४	Website निर्माण	१००,०००.००	०	०.००	९७१८०.००	९७१८०.००	२८२०.००
३११५८	फोहर व्यवस्थापन खाडल	२५०,०००.००	०	०.००	२४६८१०.७१	२४६८१०.७१	३१८९.२९
३११५८	Septic Tank	२५०,०००.००	०	०.००	२४६२०४.७४	२४६२०४.७४	३७९५.२६
३११६१	Renovation Office, Lab,	५००,०००.००	०	०.००	४९२९५७.३२	४९२९५७.३२	७०४२.६८
३११७१	सभा हलमा स्टेज	१५०,०००.००	०	०.००	१४८०५२.६०	१४८०५२.६०	१९४७.४०
३११७१	Rennovation of building	१५०,०००.००	०	०.००	१४९७२४.००	१४९७२४.००	२७६.००
	कुल जम्मा	**२,०२७,०००.००**	**९०,४९९.००**	**१३११९३.००**	**१,७३४,५६४.८५**	**१,९५६,२५६.८५**	**७०,७४३.१५**

Annex 13. राजश्व विवरण आ. ब. २०७७/७८ (२०२०/२१)

आम्दानीको श्रोत	जम्मा रकम (रु.)	कैफियत
बाली तथा बागवानी अनुसन्धान	५७९५४	सेवा नमूना र अनुसन्धान नमूना परिक्षण बाट प्राप्त भएको
बाली तथा बागबानी उत्पादन	१२७१८	विभिन्न परिक्षण बाट उत्पादन र सुरक्षा नमूना बिकी बाट प्राप्त भएको
बैंकमा देखिएको रकम	३५.१४	विभिन्न प्रशासनिक कार्यहरुबाट प्राप्त भएको
कुल जम्मा	७०७०७.१४	

Annex 14. बेरुजु विवरण आ. ब. २०७७/७८ (२०२०/२१)

आर्थिक वर्ष	बेरुजु रकम (रु.)	कैफियत
आ.व. २०७४/७५ देखि २०७५/७६ सम्म	८४२२५	फछ्यौटको प्रकृयामा रहेको
जम्मा बेरुजु	८४२२५	

राष्ट्रिय बीउ बिज्ञान प्रबिधि अनुसन्धान केन्द्र सम्बन्धि वेबसाइट निर्माण

कोल्ड स्टोर मर्मत संभार

भवन नं. २ को तला माथि कोठाहरु निर्माण

सेप्टिक ट्यांकि निर्माण

फोहोर ब्यबस्था कम्पोस्ट खाड निर्माण

कोल्ड रुमको लागि डी ह्युमिडी फायर

पुँजीगत सम्बन्धि मुख्य मुख्य झलकहरु

ल्यापटप खरिद

प्रिन्टर

ए.सी. खरिद गरि संचालन

टेबुल

फ्रिज

कुर्सी

हाईब्रिड मकैको गुणस्तरीय बीउ उत्पादन प्रविधि

राष्ट्रिय बीउ बिज्ञान प्रबिधि अनुसन्धान केन्द्र सम्बन्धि लिफ्लेट

रामपुर हाईब्रिड-१० मकैको हाईब्रिड बीउ उत्पादनको निरीक्षण, झापा

रामपुर हाईब्रिड-१२ मकैको ठुलो क्षेत्रफलमा प्रदशनी, सिन्धुपाल्चोक

हर्दिनाथ हाईब्रिड-१ धानको बीउ उत्पादन निरीक्षण, हर्दिनाथ

गहुँ बालीमा सुक्ष्म तत्व परिक्षण, राष्ट्रिय गहुँ बाली अनुसन्धान कार्यक्रम, भैरहवा

डा. तारा बहादुर घिमिरेज्यूको बिदाई कार्यक्रम

धान दिवस २०७८ (असार-१५)