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Productivity Increment of Lentil Adopting on-Farm Seed Priming in Rainfed Hill Environment of Nepal

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Abstract- Lentil varieties namely Shishir, Shimal, Shikhar and Khajura Masuro-2 were experimented at three locations of Myagdi, Palpa and Gorkha districts adopting mother-baby trial design with primed and non-primed treatments with an objective of identifying and promoting seed priming technology of lentil in rainfed environment of western hills in Nepal. Combined results of mother trials over sites of three districts revealed that in lentil primed seeds flowered and attained maturity 2-3 and 3-6 days earlier compared to non-primed counterpart. In an average grain yield increament was recorded 13.6% and reached up to 19.4% in Shimal due to priming. Both genotype and location specific effect on observed traits due to priming were recorded. Khajura Masuro-2 (1507 kg ha-1) and Shikhar produced highest grain yield under primed and non-primed (1408 kg/ha) situation, respectively. Combined farmers' feedback from babies showed better germination and good plant stand of soaked seeds over non-soaked. Earlier maturity in Shimal was feedback from 95.8% of the respondents. Better results of primed seeds for grain yield production in Khajura Masuro-2, Shishir, Shikhar and Shimal were claimed by 75.0%, 83.3%, 91.7% and 95.8% of participating farmers, respectively. Huge percentage (91.7 to 95.8 %) of farmers showed their keen tnterest to continue this technology in future, too.

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I. Introduction

Among the pulses, lentil ranks third in the western hills after black gram and soyabean in terms of area (1614 ha) and production (1778 Mt.) with productivity of 1102 kg ha^{-1}. It occupies 62.92% (205939 ha) of the total (327321 ha) pulses' area with 69.58% (253041 Mt.) grain production in Nepal with average productivity of 1113 kg ha^{-1} (MoAD, 2017). Lentil is the cheapest source of protein, and rich in calcium and iron for human diet particularly for the women, children, elderly population and resource-poor community of the country. In Nepal, its straw is used as animal feed. Similarly, it enhances fertility status of soil and checks soil erosion as cover crop. Along with varietal improvement, there is an urgent need to enhance overall production and productivity of this crop adopting suitable agronomic management practices (Anonymous, 2002a). Darai and his colleagues (2008) stated that according to FAOSTAT (2004), in the world export market Nepali lentil's share is about 2%. In Nepal, lentil is generally grown as a rainfed winter crop relying on residual soil moisture which results moisture stress during sowing and podding (Darai et al., 2008) periods resulting reduced yield.

Various methods of seed priming viz. on-farm seed priming, hydro-priming, halo priming (organic salts like NaCl, $KN0_3$, $CaCl_2$, $CaS0_4$ etc. are used in soaking seeds), osmo-priming (seeds are soaked in solutions of sugar, polyethylene glycol, glycerol, sorbitol, or mannitol) and hormonal priming (kinetin, ascorbate, salicylic acid etc.) are being experimented on lentil (Harris; Binang et al., 2012; Nawaz et al., 2013; Pakbaz et al., 2014; Toklu, 2015 and Singh et al., 2017). Seed priming of lentil, chickpea, rice and wheat with micronutrients (B, Zn and Mo) was also experimented (Johnson et al., 2005). Likewise, lentil seed priming with various micronutrients viz. KI (Potassium iodide), copper iodide (CuI), zinc iodide (ZnI_2) and zinc sulphate ($ZnSo_4$) were used by Aliloo and his colleagues (2014). With an objective of identifying affordable seed priming agent of lentil for resource-poor farmers where price of commercial vitamins, antioxidants or nutrients is very high, aqueous plant extracts (*Aloe vera, Moringa olifera* and sugar beet) were also used to enhance rate of germination and seedling growth under chilling conditions (Imran et al., 2014). Seed priming is a useful technology to enhance germination, earlier germination, seedling vigour, stand establishment, competitiveness against weeds, number of tillers, number of fertile tillers, grain yield and tolerance to drought periods. Similarly, it reduces seedling emergence period, duration to maturity and incidence of diseases, and avoids the need for re-sowing in many field crops (Rashid et al., 2002; Binang et al., 2012; Nawaz et al., 2013; Arjmand et al., 2014; Koirala, 2017 and Sharma et al., 2017). Both in legumes and cereals mean grain yield increment was in between zero and 200%, and average increase was about 30% (Harris, 2004). However, effect on yield or micronutrient content of the progeny seeds was not recorded sowing micronutrient (B, Zn and Mo) primed seeds in rice, wheat, lentil and chickpea (Johnson et al., 2005). The hydro-priming improved the morphology of germinated seeds of *Cucurbita pepo* (Bankaji et al., 2017).

Poor seed germination and crop establishment, and needs of re-sowing in some of the cases resulting lower yield are the major problems in lentil growing areas in Nepal. On-farm lentil seed priming/seed soaking

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is a simple technology where seed is soaked in tap water for less than "safe limit" i.e. 12 hours. Then, seeds are surface dried by spreading them in the shade for two hours and sown the same day. Seed priming is a low cost and low risk intervention which increases and stabilizes yields. Thus, this technology will have a large impact on the livelihoods of small scale, marginal, resource-poor and socially disadvantaged groups in community.

II. Materials and Methods

Experiments were conducted during winter season at three locations of Gorkha (Birenchok, Shikhar and Katteldanda), Myagdi (Jyamrukkot, Ratnechaur-1 and Ratnechaur-5) and Palpa (Aryabhanjyang, Khaseuli and Deurali) districts. Four varieties of lentil namely Khajura Masuro-2, Shimal, Shishir and Shikhar were evaluated in farmers' fields with primed (P) and non-primed (NP) treatments. "Mother-Baby" (MB) trial's scheme was implemented for experimentation. In baby trials (BTs), one kilogram (kg) seed of each variety was provided to four farmers at each location and asked to prime half of seed in water for 12 hours, then surface dry and sow using normal practices adjacent to a plot using non-primed seed. This trial was managed and led by farmers themselves. Thus, sixteen farmers were involved in BTs at a location. In addition to that, in a centrally situated area of each location a complete set of trial, called mother trial (MT) consisting of four improved varieties used in BTs was tested. MTs provided opportunity to farmers, extension workers and researchers to evaluate and compare the performance of tested technologies in one spot. Thus, total 17 farmers at a location, 51 in a district and 153 in the project participated in testing and verifying lentil seed priming technology.

Farmers compared the performance of each variety with primed and non-primed treatments in BTs and all four varieties together in MTs from planting to post-harvest management. Individual farmer's opinions were collected through a household level questionnaire (HLQ) using matrix ranking where the primed treatment was compared to non-primed counterpart as better, same or worse. In HLQ, feedback was collected on ease to planting, time to germination, plant stand after germination, growth of the plants, days to flowering, weed problem, disease and insect pests problem, drought tolerance, days to maturity, grain size, grain yield and plan for next year planting.

Plot size of MT was 3m × 2m. Seed rate was 20 kg ha^{-1}. Row to row distance was 25 cm and continuous planting within rows. Fertilizers were applied @20:20:40 $N:P_2O_5:K_20$ kg ha^{-1}. Six central rows were used to record observations. MB trial's scheme using four varieties of lentil with primed and non-primed treatments has been presented in figure 1.

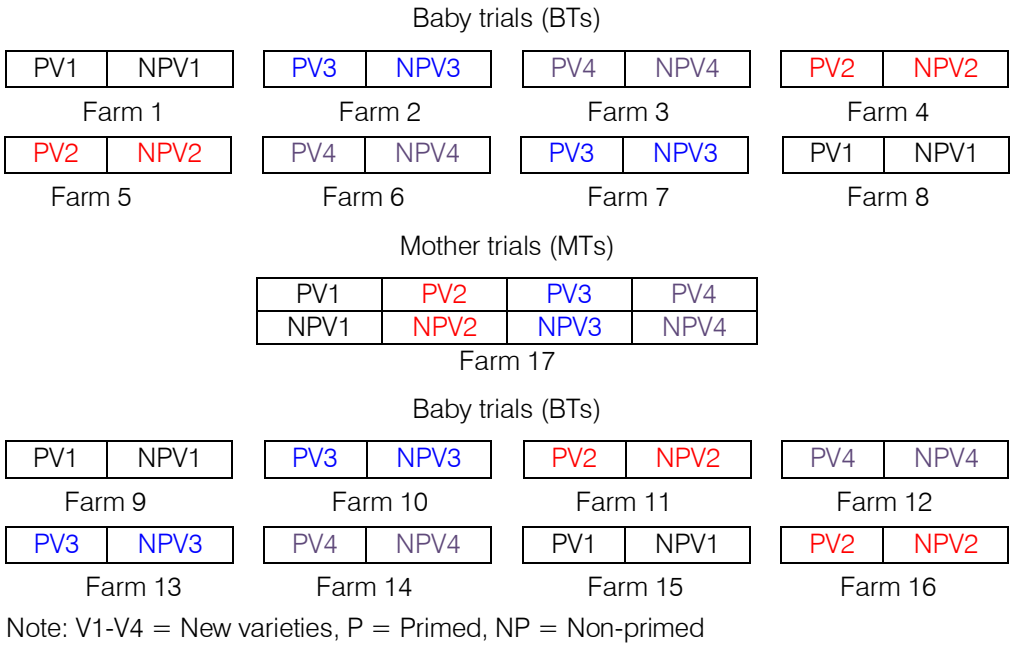

Figure 1: Mother-baby trial's scheme using four varieties of lentil with primed and non-primed treatments

III. Results and Discussion

a) Mother Trial

In Gorkha district, highest grain yield was recorded in Shikhar (1433 kg ha^{-1}) followed by Khajura Masuro-2 (1183 kg ha^{-1}) and Shishir (922 kg ha^{-1}) under primed condition which was better as compared to non-primed counterpart. Due to on-farm seed priming, yield increment at this location ranged from 1.9 (Shikhar) to 13.5% (Shimal). Both under primed and non-primed treatments, in Palpa district, varieties namely Khajura Masuro-2 (1561 and 1200 kg ha^{-1}), Shishir (1528 and

1194 kg ha^{-1}) and Shikhar (1367 and 1097 kg ha^{-1}) produced higher yield. Primed seed produced 24.6 (Shikhar) to 49.3% (Shimal) higher yield compared to non-primed seeds. In Myagdi, all the tested genotypes except Shikhar produced higher grain yield under primed condition and ranged from -3.3 to 12.8 (Khajura Masuro-2). Results when combined over locations under primed situation, Khajura Masuro-2 (1507 kg ha^{-1}) was the top yielder followed by Shikhar (1489 kg ha^{-1}) and Shishir (1418 kg ha^{-1}), respectively. Highest grain yield was recorded in Khajura Masuro-2 and Shikhar (1408 kg ha^{-1}) under primed and non-primed environment, respectively. Percent yield increment was in between 5.8 (Shikhar) and 19.4% (Shimal) with average increment of 13.6%. Results have been summarized in Table 1. Seed yield increase due to priming in lentil by 31.4 to 36.8% (Neupane, 2002 and Anonymous, 2002b), 24 to 44% (Clements et al., 2003) and 26% (Darai et al., 2008) was recorded. Genotype specific response to yield and other traits due to on-farm seed priming was also recorded (Pakbaz et al., 2014) as we observed in our experiments.

Table 1: Grain yield (kg ha^{-1}) of tested lentil genotypes under primed and non-primed conditions at various locations

Variety	Gorkha			Palpa			Myagdi			Combined over locations		
	Primed	Non-primed	% increment over NP	Primed	Non-primed	% increment over NP	Primed	Non-primed	% increment over NP	Primed	Non-primed	% increment over NP
Shimal	889	783	13.5	1103	739	49.3	1603	1486	7.9	1198	1003	19.4
Khajura Masuro-2	1183	1089	8.6	1561	1200	30.1	1777	1575	12.8	1507	1288	17.0
Shikhar	1433	1406	1.9	1367	1097	24.6	1666	1722	-3.3	1489	1408	5.8
Shishir	922	833	10.7	1528	1194	28.0	1805	1694	6.6	1418	1241	14.3
Mean	1107	1028	7.7	1390	1058	31.4	1713	1619	5.8	1403	1235	13.6
Minimum	889	783	1.9	1103	739	24.6	1603	1486	-3.3	1198	1003	5.8
Maximum	1433	1406	13.5	1561	1200	49.3	1805	1722	12.8	1507	1408	19.4

Days to flowering of the primed genotypes were found earlier as compared to non-primed seeds which ranged from 2-4, 1-4 and 2-6 days in Gorkha, Palpa and Myagdi districts, respectively. Combined results showed that primed seeds of Khajura Masuro-2 and Shikhar flowered 3 days earlier, and Simal and Shishir flowered 4 days earlier as compared to non-primed seeds. Detail results have been presented in Table 2. These primed seeds of various genotypes not only flowered earlier but also matured earlier at all locations. The maturity period of primed seeds as compared to non-primed was recorded earlier by 3-6 and 2-6 days in Gorkha and palpa, respectively. Primed genotypes attained maturity 3-6 days earlier as compared to their non-primed counterparts when combined over locations. Findings have been highlighted in Table 3. Better germination, increased plant stand and increased biomass yield was also recorded (data not presented). Reduced time to germination and enhanced root growth (Clements, 1998 and Clements et al., 2003) were recorded using lentil's primed seeds in laboratory. Better germination, reduced days to 50% emergence, satisfactory seedling emergence, better and uniform plant stand, increased number of pods per plant, larger seed size, increased seed weight per plant, higher seed yield, increased plant height, increased number of primary branches, total biomass yield and harvest index reducing cost of production are the benefits of lentil seed priming for 12 hours (Anonymous, 2002b; Neupane, 2002 and Sharma et al., 2017). In addition to increased seed yield, better grain filling, early maturity (1 week), and less diseases and insectpests problems were identified as additional advantages of primed seeds compared to non-primed counterparts (Darai et al., 2008) reducing risk of crop failure. Similarly, seed priming experiments on improved varieties combined in one exercise provide exposure to new varieties and varietal selection options to growers.

Table 2: Mean days to flowering of lentil varieties under primed and non-primed treatments at various locations

Variety	Gorkha			Palpa			Myagdi			Combined over locations		
	Primed	Non-primed	Days earlier in P	Primed	Non-primed	Days earlier in P	Primed	Non-primed	Days earlier in P	Primed	Non-primed	Days earlier in P
Shimal	70	73	3	75	79	4	73	78	5	73	77	4
Khajura Masuro-2	71	74	3	72	73	1	72	78	6	72	75	3
Shikhar	76	78	2	72	75	3	75	77	2	74	77	3
Shishir	74	78	4	72	75	3	73	79	6	73	77	4
Mean	73	76	3	73	76	3	73	78	5	73	76	3
Minimum	70	73	2	72	73	1	72	77	2	72	75	3
Maximum	76	78	4	75	79	4	75	79	6	74	77	4

Table 3: Mean days to maturity of lentil varieties under primed and non-primed treatments at various locations

Variety	Gorkha			Palpa			Combined over locations		
	Primed	Non-primed	Days earlier in P	Primed	Non-primed	Days earlier in P	Primed	Non-primed	Days earlier in P
Shimal	117	120	3	123	129	6	120	125	5
Khajura-2	117	121	4	122	126	4	120	123	3
Shikhar	123	129	6	124	126	2	124	128	4
Shishir	120	125	5	122	128	6	121	127	6
Mean	119	124	5	123	127	4	121	126	5
Minimum	117	120	3	122	126	2	120	123	3
Maximum	123	129	6	124	129	6	124	128	6

b) Baby Trials

Feedback from baby trials was recorded from each individual farmer for different pre and post-harvest traits of each variety (Tables 4-7). Farmers' response combined over locations (Table 7) showed that 29.2-45.8% respondents expressed their opinion on the favour of easy planting of primed seed. Stand establishment after germination in soaked seeds was observed better as reported by 29.2-54.2% of the respondents. Genotype Shimal attained earlier maturity as claimed by 95.8% of participating farmers. Majority of the respondents reported non-significant differences in primed and non-primed treatments for weed, disease and insect problems. Sililarly, 91.7%, 95.8%, 83.3% and 75.0% of collaborators reported better performance of primed seed over non-primed in Shikhar, Shimal, Shishir and Khajura Masuro-2, respectively. Likewise, 91.7 to 95.8 % farmers involved in lentil seed priming experiments showed their keen interest to continue lentil seed priming technology in future. Farmers' preferences of lentil genotypes with and without priming treatments in different districts (combined over sites) and combined over locations have been summarised and presented in Tables 4-7. Based on farmers' perceptions in HLQ, focus group discussions (FGD), field day and inter-district observation tour, farmers of Gorkha preferred Shikhar and Shishir whereas in Palpa and Myagdi, Shishir and Khajura Musuro-2 varieties were preferred by farmers. It is recorded that on-farm seed priming technology is not suitable both for too dry and excess moisture conditions. These findings are also supported by Darai and his colleagues (2008). They added, primed seeds emerged 3 days earlier, grew faster, and flowered earlier, showed better drought tolerance and formed grain earlier than non-primed seeds and farmers are able to harvest higher yields 7-10 days earlier than normal sowing.

Table 4: Farmers' preferences on seed priming of different lentil varieties in baby trials, Gorkha

Trait	Shikhar			Simal			Shishir			Khajura Masuro-2		
	1 (%)	2 (%)	3 (%)	1(%)	2 (%)	3 (%)	1 (%)	2 (%)	3(%)	1 (%)	2 (%)	3(%)
Ease to planting	91.7	8.3	0.0	66.7	16.7	16.7	88.9	11.1	0.0	100.0	0.0	0.0
Time to germinate	91.7	8.3	0.0	66.7	0.0	0.0	100.0	0.0	0.0	75.0	25.0	0.0
Plant stand after germination	66.7	33.3	0.0	50.0	50.0	0.0	88.9	11.1	0.0	83.3	16.7	0.0
Growth of the plant	83.3	16.7	0.0	50.0	50.0	0.0	83.3	16.7	0.0	91.7	8.3	0.0
Days to flowering	58.3	41.7	0.0	27.8	72.2	0.0	83.3	16.7	0.0	66.7	33.3	0.0
Weed problem	11.1	88.9	0.0	11.1	88.9	0.0	0.0	100.0	0.0	33.3	66.7	0.0
Insect/pest problem	0.0	100.0	0.0	11.1	88.9	0.0	8.3	91.7	0.0	33.3	66.7	0.0
Drought tolerance	8.3	91.7	0.0	50.0	50.0	0.0	47.2	52.8	0.0	33.3	66.7	0.0
Maturity	75.0	25.0	0.0	16.7	83.3	0.0	91.7	8.3	0.0	33.3	58.3	8.3
Grain size	25.0	75.0	0.0	50.0	50.0	0.0	41.7	58.3	0.0	50.0	50.0	0.0
Grain yield	75.0	25.0	0.0	50.0	50.0	0.0	100.0	0.0	0.0	41.7	50.0	8.3
Plan for next year planting	100.0	-	0.0	47.2	-	52.8	91.7	-	8.3	83.3	-	16.7

Note: 1(%), 2(%), 3(%) – percent respondents reporting better, similar and worse result, respectively of primed seed over non- primed counterpart for each trait

Table 5: Farmers' preferences on seed priming of different lentil varieties in baby trials, Palpa

Trait	Shikhar			Simal			Shishir			Khajura Masuro-2		
	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)
Ease to planting	41.7	58.3	0.0	50.0	50.0	0.0	41.7	58.3	0.0	50.0	50.0	0.0
Time to germinate	100.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0
Plant stand after germination	41.7	58.3	0.0	75.0	25.0	0.0	58.3	41.7	0.0	41.7	58.3	0.0
Growth of the plant	91.7	8.3	0.0	91.7	8.3	0.0	83.3	16.7	0.0	66.7	33.3	0.0
Days to flowering	91.7	8.3	0.0	100.0	0.0	0.0	91.7	8.3	0.0	75.0	25.0	0.0
Weed problem	0.0	100.0	0.0	0.0	100.0	0.0	16.7	83.3	0.0	0.0	100.0	0.0
Insect/pest problem	0.0	100.0	0.0	0.0	100.0	0.0	0.0	91.7	8.3	0.0	100.0	0.0
Drought tolerance	58.3	41.7	0.0	75.0	25.0	0.0	75.0	16.7	8.3	41.7	58.3	0.0
Maturity	91.7	8.3	0.0	91.7	8.3	0.0	83.3	16.7	0.0	75.0	25.0	0.0
Grain size	91.7	8.3	0.0	83.3	16.7	0.0	83.3	16.7	0.0	66.7	33.3	0.0
Grain yield	91.7	8.3	0.0	91.7	8.3	0.0	83.3	16.7	0.0	66.7	33.3	0.0
Plan for next year planting	91.7	-	8.3	83.3	-	16.7	91.7	-	8.3	83.3	-	16.7

Note: 1(%), 2(%), 3(%)–percent respondents reporting better, similar and worse result, respectively of primed seed over non-primed counterpart for each trait

Table 6: Farmers' preferences on different traits under lentil seed priming in baby trials, Myagdi

Trait	Shikhar			Simal			Shishir			Khajura Masuro-2		
	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)
Ease to planting	16.7	83.3	0.0	8.3	91.7	0.0	16.7	83.3	0.0	41.7	58.3	0.0
Time to germinate	100.0	0.0	0.0	91.7	8.3	0.0	91.7	8.3	0.0	100.0	0.0	0.0
Plant stand after germination	33.3	66.7	0.0	33.3	66.7	0.0	50.0	50.0	0.0	16.7	83.3	0.0
Growth of the plant	58.3	41.7	0.0	41.7	58.3	0.0	16.7	83.3	0.0	25.0	75.0	0.0
Days to flowering	83.3	16.7	0.0	100.0	0.0	0.0	100.0	0.0	0.0	91.7	8.3	0.0
Weed problem	0.0	100.0	0.0	0.0	100.0	0.0	8.3	91.7	0.0	0.0	100.0	0.0
Insect/pest problem	8.3	91.7	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0
Drought tolerance	8.3	91.7	0.0	0.0	100.0	0.0	8.3	91.7	0.0	16.7	83.3	0.0
Maturity	91.7	8.3	0.0	100.0	0.0	0.0	100.0	0.0	0.0	91.7	8.3	0.0
Grain size	16.7	83.3	0.0	0.0	100.0	0.0	8.3	91.7	0.0	0.0	100.0	0.0
Grain yield	91.7	8.3	0.0	100.0	0.0	0.0	83.3	16.7	0.0	83.3	16.7	0.0
Plan for next year planting	91.7	-	8.3	100.0	-	0.0	100.0	-	0.0	100.0	-	0.0

Note: 1 (%), 2 (%), 3 (%)–percent respondents reporting better, similar and worse result, respectively of primed seed over non-primed counterpart for each trait

Table 7: Farmers' preference on different traits of lentil with soaked and non-soaked seeds in baby trials combined over locations

Trait	Shikhar			Simal			Shishir			Khajura Masuro-2		
	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)	1 (%)	2 (%)	3 (%)
Ease to planting	29.2	70.8	0.0	29.2	70.8	0.0	29.2	70.8	0.0	45.8	54.2	0.0
Time to germinate	100	0.0	0.0	95.8	4.2	0.0	95.8	4.2	0.0	100.0	0.0	0.0
Plant stand after germination	37.5	62.5	0.0	54.2	45.8	0.0	54.2	45.8	0.0	29.2	70.8	0.0
Growth of the plant	75	25.0	0.0	66.7	33.3	0.0	50.0	50.0	0.0	45.8	54.2	0.0
Days to flowering	87.5	12.5	0.0	100.0	0.0	0.0	95.8	4.2	0.0	83.3	16.7	0.0
Weed problem	0.0	100.0	0.0	0.0	100.0	0.0	12.5	87.5	0.0	0.0	100.0	0.0
Insect/pest problem	4.1	95.9	0.0	0.0	100.0	0.0	0.0	95.8	4.2	0.0	100.0	0.0
Drought tolerance	33.3	66.7	0.0	37.5	62.5	0.0	41.7	54.2	4.2	29.2	70.8	0.0
Maturity	91.7	8.3	0.0	95.8	4.2	0.0	91.7	8.3	0.0	83.3	16.7	0.0
Grain size	54.2	45.8	0.0	41.7	58.4	0.0	45.8	54.2	0.0	33.3	66.7	0.0
Grain yield	91.7	8.3	0.0	95.8	4.2	0.0	83.3	16.7	0.0	75.0	25.0	0.0
Plan for next year planting	91.7	-	8.3	91.7	-	8.3	95.8	-	4.2	91.7	-	8.3

Note: 1(%), 2(%), 3(%) – percent respondents reporting better, similar and worse result, respectively of primed seed over non-primed counterpart for each trait

IV. Conclusion

At the same level of management, average grain yield increment was 13.6% and maximum of 19.4% was recorded in Shimal. Genotype and location specific effects of seed priming were observed. Varieties namely Shikhar and Shishir in Gorkha whereas Khajura Masuro-2 and Shishir in Palpa and Myagdi districts were preferred by farmers. Thus, farmers' preferences towards lentil variety was also found location specific. Varieties namely Khajura Masuro-2 (1507 kg ha^{-1}) and Shikhar (1408 kg ha^{1}) produced the highest grain yield in primed and non-primed condition, respectively. Mean days to flowering and maturity were recorded 3-4 and 3-6 days earlier of primed seeds compared to non-primed counterpart, respectively. Variety and location specific results on lentil seed priming were recorded and positive impacts of seed priming in grain yield and other quantitative traits were verified and demonstrated. Therefore, this technology should be promoted and disseminated widely using different varieties at various locations. Likewise, seed priming trials of improved varieties combined in one exercise provide exposure to new varieties and varietal selection options to growers.

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References Références Referencias

1. Aliloo, Ali Asghar, Shirin Alahyari and Seyed Bahman Mosavi. 2014. Micronutrient priming improves germination and seedling establishment in lentil. Advances in Applied Agricultural Sciences, 02(11): 37-44.
2. Anonymous. 2002a. Annual Report. National Grain Legumes Program, Rampur, Chitwan, Nepal.
3. Anonymous. 2002b. Project Status Report (July 2000 to November 2001). NARC, RARS Khajura, Nepalgunj, Banke, January 2002.
4. Arjmand, Hossein Salehi, Saeed Sharafi, Zeinolabedin Jouyban and Somaye Akhlaghi. 2014. Effects of priming on seed germination, emergence and field performance. Journal of Applied Science and Agriculture, 9(4): 1569-1573.
5. Bankaji, Insaf, Ichrak Ben Hammouda and Noomene Sleimi. 2017. Effect of priming on seed germination of cucurbita pepo under copper stress. American Journal of Life Science Researches, 5(3): 118-125. http://www.diili.org/ojs-2.4.6/index.php.ajlsr/index
6. Binang, WB, JO Shiyam and JD Ntia. 2012. Effect of seed priming method on agronomic performance and cost effectiveness of rainfed, dry-seeded NERICA rice. Research Journal of Seed Science, 5(4): 136-143. Doi: 10.3923/rjss.2012.136.143.
7. Clements, JC. 1998. Trip Report to Nepal and Pakistan, CLIMA, Australia.
8. Clements, JC, Ram K Neupane and Renuka Shrestha. 2003. Seed priming methods for increasing seedling vigour, establishment and yield In Nepal. In: Lentil Improvement in South Asia. NARC/Nepal, ICARDA/Syria, CLIMA/Australia, Held

24-28 February, Kathmandu, Nepal. Abstracts. Pp. 14.
9. Darai, R, BN Adhikari, R Shrestha and BP Wagle. 2008. Verification and dissemination of seed priming technologies on lentil for better crop establishments and seed yield under different environments of Nepal. Paper presented at the 27th National winter crops workshop held at NARC, Khumaltar during Sept. 10-12, 2008.
10. Harris, D. 2004. On-farm seed priming reduces risk and increases yield in tropical crops. Brisbane, September 2004, 4th International Crop Science Congress.
11. Harris, D. The status of 'on-farm' seed priming and related work funded by the DFID plant sciences research program: Highlights and impact. Seed priming. Pp. 115-124.
12. Imran, Shakeel, Irfan Afzal, Muhammad Amjad, Ahsan Akram, Khalid Mahmood Khawar and Seef Pretorius. 2014. Seed priming with aqueous plant extracts improved seed germination and seedling growth under chilling stress in lentil. Advances in Applied Agricultural Sciences, 2(11): 58-69.
13. Johnson, SE, JG Lauren, RM Welch and JM Duxbury. 2005. A comparison of the effects of micronutrient seed priming and soil fertilization on the mineral nutrition of chickpea (*Cicer arietinum*), lentil (*Lens culinaris*), rice (*Oryza sativa*) and wheat (*Triticum aestivum*) in Nepal. Expl. Agric., Vol. 41, Pp. 427-448. Doi:10.1017/S0014479705002851
14. Koirala, KB. 2017. Effect of seed priming on maize in the western hills of Nepal. International Journal of Applied Sciences and Biotechnology, 5(4): 470-78. Doi: 10.3126/ijasbt.v5i4.18772
15. MoAD. 2017. Statistical information on Nepalese agriculture 2072/73 (2015/16). Government of Nepal. Ministry of Agricultural Development. Monitoring, Evaluation and Statistics Division. Agri Statistics Section. Singha Durbar, Kathmandu, Nepal. 207p.
16. Nawaz, Javid, Muhammad Hussain, Abdul Jabbar, Ghulam Abbas Nadeem, Muhammad Sajid, MasoodUI Subtain and Imran Shabbir. 2013. Seed priming a technique. International Journal of Agriculture and Crop Sciences, 6(20): 1373-1381.
17. Neupane, RK. 2002. Effect of seed priming on growth and yield of lentil var. Khajura Masuro 2. In: Neupane, RK, NK Yadav and R Darai (eds.), Proceedings of National Winter Crops Workshop. Grain Legumes Research Held, September 12-14, 2002, Regional Agricultural Research Station, Parwanipur, Bara, Nepal. Pp. 59-62.
18. Pakbaz, Nasibe, Mehrshad Barary, Ali Ashrab Mehrabi and Ali Hatami. 2014. Effect of seed priming on growth and yield of lentil (*Lens culinaris* L.) genotypes under rainfed and supplimental irrigation conditions. 2014. International Journal of Biosciences, 5(9): 131-139. http://dx.doi.org /10.12692/ijb/5.9.131-139.
19. Rashid, A, D Harris, PA Hollington and RA Khattak. 2002. On-farm seed priming: a key technology for improving the livelihoods of resource-poor farmers on saline lands. In: Ahmad, R and KA Malik (eds.), prospects for saline agriculture, Pp. 423-431.
20. Sharma Pradip Kumar, AK Chaurasia, Chchchida Nand Mishra. 2017. Effect of organic and inorganic seed priming on seed quality parameters in lentil (*Lens culinaris* Medik.) seeds. The Pharma Innovation Journal, 6(10): 18-21.
21. Toklu, Faruk. 2015. Effects of different priming treatments on seed germination properties, yield components and grain yield of lentil (*Lens culinaris* Medik.). Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 43(1): 153-158. Doi:10.15835/nbha 4319832.

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