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Performance evaluation of lentil and chickpea genotypes in Doti district of Nepal

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Abstract

Lentil and chickpea are important winter legumes of Nepal. The experiments were carried out to evaluate the agronomic performance of lentil and chickpea genotypes at research field of Regional Agricultural Research Station (RARS), Bhagetada, Doti, Nepal during winter seasons of 2012 and 2013. The 16 lentil genotypes were evaluated in both years whereas 20 and 14 genotypes of chickpea were evaluated in 2012 and 2013 respectively. The genotypes were evaluated in a randomized complete block design with three replications. The results showed that both lentil and chickpea genotypes indicated differences for their morphological traits namely plant height, flowering, maturity, pods/plant and grain yield. The combined analysis of trials over years showed that lentil genotype namely Black Masuro produced the highest grain yield (790 kg/ha) followed by LG 12 (746 kg/ha) and ILL 3111 (747 kg/ha), respectively. Similarly, chickpea genotypes namely ICCX 840508-31 produced the highest grain yield (953 kg/ha) followed by ICCX 840508-40 (911 kg/ha) and BG 372 (850 kg/ha), respectively. It is suggested that the superior genotypes derived from these experiments could be further evaluated in farmers' fields before making recommendation for general cultivation.

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Introduction

Grain legumes (Pulses) are an important component of cropping system of Nepal. In the mountains and hills, grain legumes are primarily for home consumption, while in the terai and also in some warmer valleys, they are grown both for home consumption and market. The bulk of production in the terai and inner terai is from the winter grain legumes such as lentil, chickpea, field peas and grasspea and in the summer from pigeon pea (Neupane and Shrestha, 2015). Lentil locally known as Masuro is one of the major pulse crop of Nepal accounting 62% area and 64% production of the total legume (MOAD, 2013). In Nepal, during 2016/17 lentil was cultivated in the total area of 206,969 ha and the total production was 254,308 t with productivity of 1,229 kg/ha (MoALD, 2017). Lentil is either grown as relay crop

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(no till, seed broadcasted 1-2 weeks prior to paddy to harvest) or after rice harvest and land cultivated (post-rice system), and to a smaller extent grown mixed with wheat, tori, mustard, linseed and field pea. Inclusion of lentil in cereal based cropping systems helps in sustainable productivity by improving fertility status of soil, and thereby reducing use of chemical fertilizers and pesticides. Lentils are grown in terai, inner terai and mid hills of the country. The cultivation of lentil has been increased because of increasing preference for its internal consumption and potential for export market. Nepalese lentils have greater demand in the international market. Bangladesh, Singapore, SriLanka, Germany, Korea, UK, Indonesia are the major importers. Lentil is recognized as one of the major agricultural product with high export potential and medium socio-economic impacts by Nepal Trade Integration Strategy (NTIS) (MOCS, 2010). Lentil shares about 3.1% of the total lentil export in the world (USAID, 2011).

Chickpea is an important winter legume grown mainly in the rainfed area of Nepal, mainly in the rice or maize based ecosystem either as a sole or mixed crop with other winter crops. It is an important legume to the population, as it is the primary protein source for nearly 2 million Nepalese people (Pande et al., 2005).Chickpea is an excellent source of protein, especially when compared to other legume pulses. It is high in unsaturated fatty acids and minerals, including calcium, magnesium, phosphorus and potassium (Jukanti, 2012). Chickpea is mainly used for human consumption as well as for feeding animals. It is used as 'Dal' in split form. Whole fried or boiled seeds of chickpea are also eaten. Husk and bits of 'Dal' are used as nutritious feed for animals. Green leaves of chickpea are used as vegetable (sag). Grains are also used as vegetable (chhole). Flour is used in the preparation of various sweets. It is also mixed with wheat flour for 'chapati' making. Chickpea can also be used as green fodder. Its straw is an excellent fodder for animals.In Nepal, during 2016/17 chickpea was cultivated in the total area of 9,933 ha and total production was 10,969 t with productivity of 1,104 kg/ha (MoALD, 2017). Far western hills have only 10 ha cultivated area of chickpea with the average productivity of 453 kg/ha which is 54.28% lower than the national average productivity.

The information on varietal suitability of lentil and chickpea for far western hills of Nepal was not sufficient so with the objective of identifying high yielding and agronomically superior lentil and chickpea genotypes for this regions, these experiments were carried out at RARS, Bhagetada, Doti, Nepal.

Materials and Methods

Description of the experimental site

These experiments were carried out in the research field of Regional Agricultural Research Station (RARS), Bhagetada, Dipayal, Doti district during winter seasons of 2012 and 2013. The site is located at the latitude of N 29°15'16.4" and longitude of E 80°55'59.3". This research station is situated at the bank of Seti River with the altitude of 546 meter above sea level. (Prasai et al., 2018). The soil was light texture, low organic matter (1-2%) and acidic in nature containing pH 6 (RARS, 2015).

Plant Materials

Total sixteen lentil genotypes namely ILL 7715, ILL 6467, LG 124, ILL 7537, ILL 1, PL-4, ILL 3111, ILL 6256, ILL 3490, ILL7979, WBL 77, HG 57, ILL9926, Black Masuro, Shital and Sagun were included in these experiments for 2012. Similarly, sixteen genotypes namely ILL

6467,LG 12, LN 0136, ILL 7715, ILL 7163, PL 4, RL 4, ILL 6819, WBL 77, ILL 3111, ILL 3490, ILL 7979, Black Masuro, HG 57, Shital and Sagun were included in the experiments for 2013.

Twenty genotypes of chickpea, namely ICCX 840508-40, ICCX 840508-44, ICCX 840508-33, ICCX 840508-38, ICCV 98933, ICCX 840508-41, KWR 108, BG 1206, KPG-59, ICCX 840508-32, ICCV 98909, BG 372, ICCV 98937, ICCX 840508-31, ICCX 840508-21, KPG 173-4, ICCV 87312, ICCX 840508-36, Tara and Dhanush were included in the experiment for 2012. Similarly, fourteen genotypes namely ICCV 87312, ICCV 98937, ICCX 840508-31, ICCX 840508-38, ICCX 840508-40, ICCX 840508-41, ICCX 840508-44, KWR 108, ICCV 98933, ICCV 98909,KPG 59, BG 372, Tara and Dhanush were included in the experiments for 2013.

Experimental design and field management

The experiments were laid out in Randomized Complete Block Design with three replications in both years. For lentil the plot size of 4.5 m^2 was maintained in both years. For chickpwa, plot size was of 7.2 m^2 in both the years. The chemical fertilizers was applied by the rate of 20:40:20 NPK kg/ha. The cultural practices and plant protection measures were applied as per recommendations made by Grain Legume Research Program, Khajura, Banke.

Data Analysis

The traits namely days to flowering, days to maturity, plant height, pods/plant, seed/pod, and grain yield were recorded. Analysis of variance for agronomic traits of grain legumes were analyzed with MSTATC software (Russel & Eisensmith, 1983). Genotypes were compared using the F-test. The treatment means were compared by the Least Significant Difference (LSD) test at 5% level (Gomez & Gomez, 1984; Shrestha, 2019).

Results and Discussion

Results

Lentil

Among the lentil genotypes evaluated in 2012, ILL-3111 produced the highest grain yield (764 kg/ha) followed by LG 124 (688 kg/ha) and ILL 6467 (626 kg/ha), respectively. Statistically, grain yield and days to flowering showed significant differences among the genotypes (Table 1). The genotypes ILL-3111, LG 124 and ILL 6467 produced 46.08, 31.54 and 19.69% higher grain yield than the standard check variety (Shital).

Total 16 genotypes of lentil were included in the experiments in 2013. Among them, LG 12 producedd the highest grain yield (1050 kg/ha) followed by Black Masuro (983 kg/ha) and IL 3111 (879 kg/ha), respectively. Differences for flowering days and maturity was found highly significant and grain yield was found significant among genotypes (Table 2).

Table 1. Gain yield and growth traits of lentil genotypes at RARS Bhagetada, Doti during winter season of 2012

S. N.	Genotype	Flowering day	Maturity day	Plant height (cm)	Pods/plant	Grain yield (kg/ha)
1	ILL 7715	104	137	25.00	79	593
2	ILL 6467	103	138	22.25	93	626
3	LG 124	103	137	23.50	71	688

4	ILL 7537	105	138	23.00	68	420
5	ILL-1	101	149	22.75	68	595
6	PL-4	104	139	23.50	67	484
7	ILL-3111	100	137	26.50	87	764
8	ILL 6256	106	138	18.50	58	372
9	ILL 3490	104	137	22.50	78	604
10	ILL 7979	105	138	21.75	60	428
11	WBL-77	104	139	22.75	74	432
12	HG 57	104	138	22.75	79	578
13	ILL 9926	101	134	21.75	57	386
14	Black Masuro	107	139	23.00	87	484
15	Shital	102	134	24.50	65	523
16	Sagun	105	138	24.00	77	542
	F-test	**	ns	ns	ns	*
	CV %	2.16	5.82	13.12	14.62	20.97
	SEm (±)	0.52	0.829	0.43	2.67	27.9

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

Table 2. Gain yield and growth traits of lentil genotypes evaluated at RARS Bhagetada, Doti during winter season of 2013

S. N	Genotype	Flowering day	Maturity day	Plant height (cm)	Pods/plant	Seeds/pod	Grain yield (kg/ha)
1	ILL 6467	102	146	21.73	28	1	509
2	LG 12	101	146	22.27	37	2	1050
3	LN 0136	105	148	20.20	32	2	799
4	ILL 7715	104	147	19.60	28	2	754
5	ILL 7163	101	146	26.80	51	2	637
6	PL 4	106	149	24.00	31	2	638
7	RL 4	106	148	22.27	39	2	727
8	ILL 6819	100	145	21.20	33	2	675
9	WBL 77	107	149	23.20	28	2	697
10	ILL 3111	104	147	25.00	56	2	879
11	ILL 3490	101	145	22.03	33	2	633

12	ILL 7979	104	147	26.07	26	2	550
13	Black Masuro	106	149	21.87	54	2	983
14	HG 57	104	147	25.27	44	2	824
15	Shital	102	146	25.47	32	2	593
16	Sagun	104	147	25.67	34	2	718
	F-test	**	**	ns	ns	ns	*
	CV%	0.66	0.35	17.71	26.23	16.13	20.43
	SEm (±)	0.541	0.314	0.553	2.4	0.0441	37.2

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

The genotypes LG 12, Black Masuro and IL 3111 produced 77.06, 65.76 and 48.22% higher grain yield respectively than standard check variety (Shital).

Combined analysis over years (2012 and 2013) showed that the genotypes namely Black Masuro (789 kg/ha), LG 12 (746 kg/ha) and ILL 3111(747 kg/ha) were found high yielding genotypes that produced 53.20, 44.85 and 45.04% higher grain yield, respectively than check variety (Shital). Statistically, genotypic variance and variance due to interaction between genotype and year (G ×Y) for grain yield were found significant. Flowering days and maturity also revealed highly significant differences among the genotypes (Table 3).

Chickpea

A total of 20 genotypes of chickpea were included in experiments in 2012.Among them, KPG 173-4 produced the highest grain yield (687 kg/ha) followed by ICCX 840508-40 (514 kg/ha) and BG 1206 (501 kg/ha), respectively. The genotypes KPG 173-4 produced the 29.37% higher grain yield than check variety (Tara). All the characters except plant height and grain yield showed non-significant differences due to genotypes. The genotypic variance was significant for grain yield and highly significant for plant height (Table 4).

Similarly, 14 genotypes of chickpea were included experiments in 2013. Among them, ICCX 840508-31 produced the highest grain yield (1463 kg/ha) followed by BG 372 (1208 kg/ha) and ICCV 87312 (1197 kg/ha) respectively. The genotypes ICCX 840508-31, BG 372 and ICCV 87312 produced 70.31, 40.62 and 39.34% higher yield respectivley than check variety (Tara). Statistically, days to flowering and maturity showed highly significant difference due to genotypes, whereas grain yield due to genotypes was found significant (Table 5).

The chickpea genotypes namely ICCX 840508-31 (953 kg/ha), ICCX 840508-40 (911 kg/ha) and BG 372 (850 kg/ha) found high yielding genotypes from combined analysis over years (2012-2013). These promising namely ICCX 840508-31, ICCX 840508-40 and BG 372 produced 37.12, 31.07 and 22.30% higher yield than the check variety (Tara).Statistically, effect of the genotypes for grain yield was significant. Similarly the interaction between genotypes and years (G×Y) for grain yield was also found highly significant (Table 6).

Table 3. Combined analysis (over years; 2012 and 2013) of lentil genotypes for grain yield and growth traits at RARS, Bhagetada, Doti during winter seasons

S. N.	Genotype	Flowering day	Maturity day	Plant height (cm)	Grain yield (kg/ha)
1	ILL 3464	103	142	20.76	474
2	LG 12	103	142	21.47	746
3	IL 7715	104	142	21.80	632
4	PL-4	105	144	24.10	545
5	WBL 77	106	145	21.93	465
6	ILL 3111	103	142	24.33	747
7	ILL 3490	103	141	22.02	516
8	ILL 7979	105	143	23.37	591
9	Black Masuro	107	144	22.10	789
10	HG 57	105	143	23.30	646
11	Shital	102	141	24.73	515
12	Sagun	104	143	24.83	619
	F-test				
	Genotype (G)	**	**	ns	*
	Year (Y)	ns	**	ns	**
	G ×Y	ns	ns	ns	ns
	CV %	1.56	1.18	16.19	20.97
	SEm (±)	0.423	0.355	0.400	31.746

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

Table 4. Gain yield and growth traits of chickpea genotypes at RARS Bhagetada, Doti during winter season of 2012

S. N.	Genotype	Flowering day	Maturity day	Plant height (cm)	Pods/plant	Grain yield (kg/ha)
1	ICCX 840508-40	109	146	37.67	26	514
2	ICCX 840508-44	108	152	33.00	24	463
3	ICCX 840508-33	108	152	43.33	23	464
4	ICCX 840508-38	108	155	46.00	26	321
5	ICCV 98933	108	152	42.00	25	456
6	ICCX 840508-41	108	162	37.33	21	383

7	KWR 108	108	153	40.00	21	488
8	BG 1206	108	151	46.00	24	501
9	KPG-59	109	151	41.00	16	418
10	ICCX 840508-32	109	149	38.67	25	342
11	ICCV 98909	108	150	43.67	25	396
12	BG 372	109	150	38.00	30	459
13	ICCV 98437	108	149	39.67	22	439
14	ICCX 840508-31	109	151	35.00	14	442
15	ICCX 840508-21	112	152	31.33	27	341
16	KG 173-4	111	151	47.00	23	687
17	ICCV 87312	108	153	34.67	27	394
18	ICCX 840508-36	109	152	37.67	17	374
19	Tara	104	150	32.33	21	531
20	Dhanush	106	150	32.33	28	453
	F-test	ns	ns	**	ns	*
	CV %	2.1	3.14	10.82	17.46	19.05
	SEm (±)	0.338	0.709	1.08	0.918	19.4

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

Table 5. Gain yield and growth traits of chickpea genotypes at RARS Bhagetada, Doti during winter season of 2013

S. N.	Genotype	Flowering day	Maturity day	Plant height (cm)	Pods/plant	Seeds/pod	Grain yield (kg/ha)
1	ICCV 87312	105	159	43.6	35	2	1197
2	ICCV 98937	108	159	50.73	41	2	921
3	ICCX 840508-31	105	159	49.6	28	2	1463
4	ICCX 840508-38	101	154	53.2	39	2	1124
5	ICCX 840508-40	102	155	49.4	46	2	1359
6	ICCX 840508-41	100	153	49.2	33	1	864
7	ICCX 840508-44	101	152	50	26	2	611
8	KWR 108	102	154	51.6	32	2	1062
9	ICCV 98933	100	153	53.53	24	2	833
10	ICCV 98909	101	151	47.07	36	2	1088

11	KPG 59	105	156	48.73	42	2	661
12	BG 372	97	153	49.8	28	2	1208
13	Tara	104	156	51.73	35	2	859
14	Dhanush	103	154	38.87	33	2	1187
	F-test	**	**	ns	ns	ns	*
	CV%	2.6	0.28	7.85	18.74	20.24	24.24
	SEm (±)	0.711	0.702	1.03	1.71	0.034	66.8

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

Table 6. Combined analysis (over years; 2012 and 2013) of chickpea genotypes for grain yield and growth traits at RARS Bhagetada, Doti during winter seasons

S. N.	Genotype	Flowering day	Maturity day	Plant height (cm)	Pods/plant	Seeds/pod	Grain yield (kg/ha)
1	ICCV 87312	107	156	39.13	29	2	795
2	ICCV 98937	108	154	45.20	31	1	679
3	ICCX 840508-31	107	155	42.30	25	2	953
4	ICCX 840508-38	105	155	48.77	32	1	722
5	ICCX 840508-40	105	154	41.20	35	1	911
6	ICCX 840508-41	104	153	43.27	27	1	622
7	ICCX 840508-44	105	153	43.87	26	2	462
8	KWR 108	105	154	45.80	27	2	775
9	ICCV 98933	104	153	47.77	23	1	644
10	ICCV 98909	104	151	45.37	30	2	741
11	KPG-59	107	153	45.27	28	2	465
12	BG 372	103	152	43.90	29	2	850
13	Tara	104	153	42.03	28	1	695
14	Dhanush	104	152	35.60	30	2	820
	F-test						
	Genotype (G)	**	**	**	ns	ns	*
	Year (Y)	**	**	**	**	**	**
	G × Y	**	**	ns	ns	ns	**
	CV%	0.86	0.6	10.4	11.05	18.42	20.1

SEm (±)	0.372	0.383	0.913	0.847	0.028	38.9

,, Significant at 0.05 and 0.01 probability level respectively. ns, non-significant*

Discussion

In these experiments, variation was observed in agromorphological traits among lentil and chickpea genotypes in both years. The variation on days to flowering in lentil was reported by Neupane (2013), Dugassa et al. (2014), Yadav et al. (2016) and Darai et al. (2017). The researchers Singh et al. (2006), Yadav et al. (2016) and Darai et al. (2017) have reported significant difference on this trait among evaluated lentil genotypes. These results showed the presence of inherent genetic variability among the genotypes which gives an opportunity for legume breeders to select most promising genotypes or improve those traits for variety development through selection and hybridization. Significant difference on lentil yield and yield attributing traits were also reported by Neupane (2013), Dugassa et al.(2014), Nath et al. (2014), and Kumar et al. (2016). A wide range of variation was observed for all traits under study suggesting variability among the cultivars for these traits. Results of the present experiments are in conformity with Ramanappa et al. (2013). The estimates of variability revealed that genetic variability was significant among the cultivars under study. The present findings were in accordance with Parameshwarappa et al. (2012) for plant height and days to fifty percent flowering. Therefore selection has to be precisely made based on the perse performance of the cultivars under replicated trails (Akanksha et al., 2016). Similarly, previous studies on chickpea landraces indicated significant variations for traits like plant height, days to flowering, days to maturity, number of pods per plant, and grain yield (Tesfamickael et al., 2014).

Conclusions

The lentil genotypes namely Black Masuro, LG 12 and ILL 3111 produced 53.20, 44.85 and 45.04% higher yield than the check variety (Shital). Similarly chickpea genotypes namely ICCX 840508-31, ICCX 840508-40 and BG 372 were identified as high yielding genotypes that produced 37.12, 31.07 and 22.30% higher yield respectively than the check variety (Tara) at Bhagetada, Doti, Nepal. So, these research findings suggest that these genotypes were promising genotypes for far western region of Nepal.

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