Evaluation of Garden Pea (*Pisum Sativum* L.) Genotypes for Yield and Quality Attributes under Mid-Hill Condition of Dailekh, Nepal

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Abstract

An experiment was conducted to evaluate eleven genotypes of garden pea in the field of Horticulture Research Station, Dailekh under mid hill conditions. The genotypes were evaluated in Randomized Block Design replicated thrice during 2013/14 and 2014/15. The genotype 'ARSDGP-11', a standard check, took least number of days to 50% flowering (60 days) followed by 'ARSDGP-04' (63.7 days) and 'ARSDGP-06'(64 days). Both the genotypes 'ARSDGP-02' and 'ARSDGP-3' produced the highest number of pods (23.00 /plant) followed by 'ARSDGP-09' (17.77/plant) and 'ARSDGP-07' (17.57/plant). Green pod yield was the highest in 'ARSDGP-02' (19.41 t/h) followed by 'ARSDGP-03' (18.86 t/h). As far as dry grain yield is concerned 'ARSDGP-02' was the highest yielder (2.59 t/h) followed by 'ARSDGP-08' (2.35 t/h) and 'ARSDGP-10' (2.21 t/h).

Keywords: *Pisum sativum, genotypes, variation, yield.*

Introduction

Pea (*Pisum sativum* L.), an important winter legume crop, is used as fresh green seeds or tender pods. It is a common nutritious vegetable grown in the cool season throughout the world, and contains high per cent of digestible protein (7.2g) having essential amino acids, particularly lysine. It is rich in carbohydrates (14.50 g), energy (81 kcal), sugars (5.67 g), vitamin A (139 IU), vitamin C (9 mg), and Calcium (20 mg), Phosphorus (139 mg) per 100 g of edible portion. Large proportion of garden pea is processed for consumption in off season (Javaid et al., 2002; Nawab et al., 2008; Khichi et al., 2016).

Approximately, 90 per cent of legume species of the sub-family Fabacea interact symbiotically with *Rhizobium t*o fix nitrogen. Being nitrogen–fixing legume, its importance as a soil building crop is increasing day by day as the chemical fertilizers are becoming less available and more expensive (Bilalis et al., 2012).

Garden peas are cultivated in Nepal from sub-tropical to temperate regions. Despite several cultivars in the field, the productivity of pea crop in Nepal is lower than the international standard due to factors such as adoption mostly of low yielding cultivars, poor crop management practices and poor management of disease and insect. Moreover, their qualities do not compete with varieties grown in the neighboring countries.

Several varieties are cold-hardy and survive winter under snow covering. Minimum germination occurs at 4 to 6^0 C while optimum germination occurs at 16 to 18^0C. Crops during vegetative growth withstand some frost, but during reproductive stage succumb to freezing temperatures. The productivity depends upon plant growth and yield components (Kakar et al., 2002).

The evaluation and selection of exotic and local cultivars is thus a work of continuous nature for systematic research since there exists a lot of variation in pea cultivars for different plant characters such as plant height, flowering time, maturity, yield and yield attributing characters (Khokhar *et al.,* 1988). Estimation of genetic parameters of five varieties of *Pisum sativum* L. indicated a good amount of genetic variation in the experimental materials under

investigation. For the traits studied such as seeds per pod, seed weight per plant and plant height there were high heritability along with high genetic gain indicating preponderance of additive effects (Georgieva et al., 2016). Therefore, selection programme based on these characters would be more effective in improving yield parameters of garden pea. Some cultivars have a greater adaptability while other provides a valuable source of variability in breeding materials.

The present study was thus designed to evaluate the mean performances of eleven genotypes of garden pea for screening high yielding genotypes suitable to mid-hill agro-ecological conditions. The main objective of the study was to promote varietal development in garden pea and disseminate among farmers for commercial cultivation.

Methodology

A total of eleven promising genotypes of garden pea were evaluated in RCBD replicated thrice during the consecutive years 2013/14 and 2014/15 in the field of Horticulture Research Station, Dailekh. Eleven genotypes (ten determinate types and one indeterminate types) were: 'ARSDGP-01', 'ARSDGP-02','ARSDGP-03', 'ARSDGP-04', 'ARSDGP-05', 'ARSDGP-06', 'ARSDGP-07', 'ARSDGP-08', 'ARSDGP-09', 'ARSDGP-10' and 'ARSDGP-11' (standard check). Recommended dose of 15 t/h FYM and 30 kg N: 40 kg P_2O_5:40 kg K_2O were applied. The experimental plot size was 3 x 3 (9^2m). Full dose of FYM and 52.17% Nitrogen, 100% Phosphorus and 100% Potassium of the recommended nutrients were incorporated into soil during preliminary and eventual land preparation respectively. On October 31, 2013 and November 2, 2014 the seeds of all eleven genotypes were sown in the crop geometry of 50 cm between the rows and 10 cm within the rows. Remaining 47.83% Nitrogen of the recommended nutrient was side dressed through incubated urea, and lightly irrigated after side dressing in 45 days after planting. All the intercultural operations and plant protection measures were adopted as per recommended for production technology of garden pea. A total of thirteen characters being recorded in the year 2013/14 and 2014/15 were: days to 50% germination, per cent of germination, days to 50% flowering, position of the first flower at the node, number of pods/ plant, number of seeds/pod, pod length, days to the first dry pod harvest, days to the last dry pod harvest, frequency of harvest, green pod yield, 1000 grain weight and dry seed yield. Ten randomly selected plants were used in each plot for taking observations on position of the first flower at the node, number of pods/plant, number of seeds / pod and pod length. The data of both years were recorded. Means of combined data were analyzed by analysis of variance, and test of significance was applied following the least significance difference (LSD) at 5% level.

Results and Discussion

Out of thirteen characters, the results of the first five characters are projected in Table 1. Of five yield contributing characters, only days to 50% flowering was noted to be highly significant, and position of the first flower at the node and number of pods per plant were noted to be significant where as days to 50 per cent germination and percent germination were noted to be non-significant (Table 1). The other five characters projected in Table 2 revealed four characters like number of seeds per pod, pod length, days to the first dry pod harvest and frequency of harvest to be highly significant whereas only days to the last dry pod harvest to be significant. Of remaining three characters, only dry grain yield was highly significant while green pod yield and 1000 grain weight were significant and non-significant respectively (Table 3).

Days to 50% germination ranged from 13.33 ('ARSDGP-05' and 'ARSDGP-09') to 15.33 ('ARSDGP-11'/ 'standard check') with mean value of 14.18. Per cent of germination ranged from 62.36 ('ARSDGP-10') to 70.69 ('ARSDGP-11'/ 'standard check') with the mean value of 67.48. Jatoi *et al*., 2001 studied seed germination and exhibited the results of seed germination % in five pea varieties viz., DMR-20 (98%), DMR-4 and DMR-7 (97%), Pak-10628 (94%) and WA-933 (80%) which were quite higher than in our recent study. The higher germination in their study could have been due to gene bank seed storage, germination study in lab condition, favorable temperature, moisture, and distinguishing behavior of cultivars (Gorecki *et al*., 1992).

Days to 50 % flowering was relatively early in four genotypes viz. 'ARSDGP-11'/'standard check' (60 days), 'ARSDGP-4' (63.7 days) 'ARSDGP-6' (64 days) and 'ARSDGP-05 (64.3 days) while it was considerably late in two genotypes viz.'ARSDGP-09' (85.70 days) and 'ARSDGP-3' (81.80 days). The finding of this character in the present study was nearly in agreement with those of Khan *et al*., 2013 as the inclusion of 15 genotypes in their study showed the time of 50% flowering varying between 62 days (Climax/Check) and 82.00 days (PS-810240).

The position of the first flower at the node was 6.80 in 'ARSDGP-4' followed by 7.92 in 'ARSDGP-05'. In contrast, the value was recorded proportionately high in 'ARSDGP-09'(10.16), 'ARSDGP-03'(9.20), 'ARSDGP-08'(9.20), 'ARSDGP-06'(9.12), ARSDGP-01'(9.05), and 'ARSDGP-7'(9.03) in this regard.

The lower value of position of the first flower on node (8.20) was exhibited by 'ARSDGP-11'/Check. This genotype also exhibited the least number of days to 50% flowering (60.00 days). On the other hand, the higher value of the position of the first flower on the node (10.20) and more number of days to 50% flowering (85.7 days) was shown by 'ARSDGP-09' alone. This indicates that the position of the first flower on the node is the index of time of maturity. $$$$$

Although the number of pods per plant was the highest in 'ARSDGP-02' (23.00/plant) and 'ARSDGP-03' (23.00/ plant) it was at par with those of five genotypes viz. 'ARSDGP-09' (17.77), 'ARSDGP-07' (17.57), 'ARSDGP-04' (16.90), 'ARSDGP-06' (16.84) and 'ARSDGP-01' (16.50) (Table 1).The number of pods per plant recorded in the genotypes studied in the present study is somewhat higher as compared to Jawahar Matar-2 (9.83) and PB-89 (16.43) as reported by Khichi et al., 2016.

The number of seeds/pod varied between 6.80 ('ARSDGP-09') and 8.92 ('ARSDGP-08') with the mean value of 7.90. The number of seeds per pod was significantly higher in four genotypes viz. 'ARSDGP-08' (8.92), 'ARSDGP-02' (8.74), 'ARSDGP-01' (8.25) and 'ARSDGP-10' (8.20) while rest of the six genotypes produced significantly lower number of seeds per pod viz., 'ARSDGP-09' with 6.80, 'ARSDGP-05' with 7.02, 'ARSDGP-06' with 7.12, 'ARSDGP-11'/'Standard check' with 7.12 and 'ARSDGP-03' with 7.20. Accordingly to 21 genotypes assessed and reported by Afreen et al., 2017, the maximum number of seeds per pod was 8.73 (AP-1) while the minimum was 4.73 (VRP-38). The results of their study more or less correspond with the results in the present study in spite of difference in genotypes evaluated.

The pod length was maximum in 'ARSDGP-01' (10.62 cm) while it was minimum in 'ARSDGP-06' (7.19 cm) with the mean value of 9.30. However, 'ARSDGP-01' (10.62cm) was at par with six genotypes viz. 'ARSDGP-09' (10.31 cm), 'ARSDGP-03' (10m.03 cm), 'ARSDGP-02' (9.83 cm), 'ARSDGP-10' (9.70 cm) and 'ARSDGP-08' (9.53 cm). In contrast, 'ARSDGP-06' with the shortest pod (7.19 cm) was consequentially different from those of rest of ten genotypes. The pod length of 21 genotypes reported by Afreen et al., 2017 corroborates with those of the present study since it varied between 6.22 cm and 9.66 cm in their study.

Days to first dry pod harvest varied between 133.00 ('ARSDGP-05') and 158.30 ('ARSDGP-03' and 'ARSDGP-09') with the mean value of 141.00. Days to the first dry pod harvest were relatively early in four genotypes viz., 'ARSDGP-05' (133.00), 'ARSDGP-04'(135.70), 'ARSDGP-08'(135.70), 'ARSDGP-10'(135.70) and'ARSDGP-11'/'Standard Check'(135.70) while it was remarkably late in two genotypes viz., 'ARSDGP-03' (158.30 days) and 'ARSDGP-09' (158.30 days). Days to last dry pod harvest was consequentially early in nine genotypes viz. 'ARSDGP-01'(167.30 days),'ARSDGP-02'(167.30 days), 'ARSDGP-04' (167.30 days), 'ARSDGP-05' (167.30 days), 'ARSDGP-06' (167.30 days), 'ARSDGP-07'(167.30 days), 'ARSDGP-08' (167.30 days),'ARSDGP-10' (167.30 days) and 'ARSDGP-11' (167.30 days) whereas two genotypes viz., 'ARSDGP-03' (171.00 days) and 'ARSDGP-09' (171.00 days) were late in this regard. Maximum frequency of harvest was recorded in nine genotypes: 'ARSDGP-05'(5.00), 'ARSDGP-01'(4.67), 'ARSDGP-04'(4.67), 'ARSDGP-08'(4.67), 'ARSDGP-10'(4.67-), 'ARSDGP-11'/'Standard check' (4.67), 'ARSDGP-02'(4.30), 'ARSDGP-06'(4.30) and 'ARSDGP-07'(4.00) while the minimum frequency was recorded in two genotypes viz., 'ARSDGP-03'(2.67) and 'ARSDGP-09'(2.67) (Table 2).

The green pod yield ranged from 8.60 t/h ('ARSDGP-11') to 19.41 t/h ('ARSDGP-02') with the mean value of 15.02 t/h. The green pod yield of 'ARSDGP-02' was at par with 'ARSDGP-03'(18.86), 'ARSDGP-09'(18.21), 'ARSDGP-07'(18.00), 'ARSDGP-08'(16.74), 'ARSDGP-05'(16.01), 'ARSDGP-01'(15.07) and 'ARSDGP-10'(13.47). The remaining three genotypes viz., 'ARSDGP-11'(8.60), 'ARSDGP-06'(9.30) and 'ARSDGP-04'(11.51) were statistically insignificant in terms of lower green pod yield. The findings of the experiment accords with those of study made by Khokhar *et al*., 1988 as their study revealed the green pod yields being variable between 7.59 t/ha ('Perlette') and 20.36 t/ha ('Minerette'). Thousand grain weight (g) ranged from 200.00 ('ARSDGP-01') to 240 ('ARSDGP-03'and 'ARSDGP-09') with the mean value of 221.21. The values of this character nearly corroborates with those of experiment accomplished by Georgieva et al., (2016). Dry grain yield (t/ha) was variable between 1.067 ('ARSDGP-05') and 2.59 ('ARSDGP-02') with the mean value of 1.84. Although the genotype 'ARSDGP-02' produced the highest dry grain yield (2.59 t/ha) the variation in its dry grain yield was at par with the other five genotypes viz., 'ARSDGP-08'(2.353), 'ARSDGP-10'(2.210), 'ARSDGP-07'(2.180), 'ARSDGP-03'(2.06) and 'ARSDGP-01'(2.054). Only one genotype viz., 'ARSDGP-06' was recorded to be mediocre yielding one with 1.82 t/ha. The lower dry grain yield (t/ha) was recorded in the remaining three genotypes viz., 'ARSDGP-05'(1.067), 'ARSDGP-11'/'Check'(1.097), 'ARSDGP-04'(1.163) and 'ARSDGP-09'(1.663) (Table 3). The findings of dry grain yield (t/ha) in the present experiment is a bit lower than those of experiment investigated by Georgieva et al., 2016 as maximum dry grain yield of 3.66 t/ha and minimum dry grain yield of 1.64 t/ha were reported by them.

Table 1: Mean Effects of Eleven Genotypes of Garden Pea on Germination, Days to 50% Germination, Days to 50% Flowering, Position of 1st Flower at the node and Number of pods/plant during the year 2013/14 and 2014/15 at HRS, Dailekh.

Genotypes	Days to 50 percent germination	Percent of germination	Days to 50 percent flowering	Position of the 1st flower on the node	Number of pods /plant
ARSDGP-01	13.67	64.58	71.50	9.05	16.50
ARSDGP-02	14.00	67.78	72.50	8.83	23.00
ARSDGP-03	14.00	70.28	81.80	9.20	23.00
ARSDGP-04	15.00	68.89	63.70	6.80	16.90
ARSDGP-05	13.33	65.83	64.30	7.92	15.02
ARSDGP-06	14.67	69.31	64.00	9.12	16.84
ARSDGP-07	14.33	67.22	71.20	9.03	17.57
ARSDGP-08	14.33	69.03	70.80	9.2	14.30
ARSDGP-09	13.33	65.97	85.70	10.16	17.77
ARSDGP-10	14.00	62.36	71.20	8.52	12.87
ARSDGP-11/ Check	15.33	70.69	60.00	8.20	15.34
GM	14.18	67.48	70.60	8.27	17.17
F-test	NS	NS	**	*	*
CV%	0.94	10.00	5.69	12.30	23.16
LSD(0.05)	-	-	6.77	1.16	6.73

GM= Grand Mean, NS= Non-significant, ** = Highly significant, *= Significant , CV=Coefficient of variation, LSD (0.05)=Least Significant Difference at 5% level,

Table 2. Mean Effects of Eleven Genotypes of Garden Pea on Number of Seeds /pod, Pod Length (cm), Days o the First Dry Pod Harvest, Days o the Last Dry Pod and Frequency of Harvest during the year 2013/14 and 2014/15 at HRS, Dailekh.

Genotypes	Number of Seeds /pod	Pod Length (cm)	Days o the First Dry Pod Harvest	Days o the Last Dry Pod Harvest	Frequency of Harvest
ARSDGP-01	8.25	10.62	138.30	167.30	4.67
ARSDGP-02	8.74	9.83	141.00	167.30	4.30
ARSDGP-03	7.20	10.03	158.30	171.00	2.67
ARSDGP-04	7.15	9.15	135.70	167.30	4.67
ARSDGP-05	7.02	8.71	133.00	167.30	5.00
ARSDGP-06	7.12	7.19	138.00	167.30	4.30
ARSDGP-07	7.90	9.17	141.00	167.00	4.00
ARSDGP-08	8.92	9.53	135.70	167.30	4.67
ARSDGP-09	6.80	10.31	158.30	171.00	2.67
ARSDGP-10	8.19	9.70	135.70	167.30	4.67
ARSDGP-11/Check	7.12	8.68	135.70	167.30	4.67
GM	7.90	9.30	141.00	167.97	4.21
F-test	**	**	**	*	**
CV%	7.81	8.36	8.49	9.4	16.58
LSD(0.05)	1.01	1.305	3.54	2.70	1.19

GM= Grand Mean, NS= Non-significant, ** = Highly significant, *= Significant, CV=Coefficient of variation, LSD (0.05)=Least Significant Difference at 5% level,

Table 3. Mean Effects of Eleven Genotypes of Garden Pea on Green Pod Yield, 1000 Grain Weight and Dry Grain Yield during the year 2013/14 and 2014/15 at HRS, Dailekh.

Genotypes	Green Pod Yield (t/ha)	1000 Grain Weight (g)	Dry Grain Yield (t/ha)
ARSDGP-01	15.07	200.00	2.054
ARSDGP-02	19.41	206.70	2.590
ARSDGP-03	18.86	240.00	2.060
ARSDGP-04	11.51	226.70	1.163
ARSDGP-05	16.01	206.70	1.067
ARSDGP-06	9.30	226.70	1.820
ARSDGP-07	18.00	233.30	2.180
ARSDGP-08	16.74	206.70	2.353
ARSDGP-09	18.21	240.00	1.663
ARSDGP-10	13.47	220.00	2.210
ARSDGP-11/Check	8.60	226.70	1.097
GM	15.02	221.21	1.84
F-test	*	NS	**
CV%	24.90	7.820	20.32
LSD(0.05)	6.36	-	0.6705

GM= Grand Mean, NS= Non-significant, ** = Highly significant, *= Significant, CV=Coefficient of Variation, LSD (0.05)=Least Significant Difference at 5% level,

Conclusion

The performances of eleven genotypes of garden pea were evaluated in the mid-hill conditions of mid -western Nepal. Of thirteen characters of eleven genotypes, the most yield components (number of pods per plant and number of seeds per pod), yields (green pod and dry grain) were found high in three genotypes viz., 'ARSDG-02', 'ARSDG-03' and 'ARSDG-08' in spite of being as late maturing type. On the other hand, values based on the number of days to 50% flowering and position of the first flower on the node, 'ARSDG-04' 'ARSDG-05' and 'ARSDG-11'/'Standard Check' appeared to be promising. In the nutshell, 'ARSDG-02', 'ARSDG-03', 'ARSDG-08', 'ARSDG-04', 'ARSDG-05' and 'ARSDG-11'/Standard check have to be advanced for Farmers' Field Trial in different locations within each outreach site.

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