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Assessment of Different Sowing Dates and Varieties on Growth, Yield and Quality of Seed in Garden Pea (*Pisum sativum* L.)

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A B S T R A C T

It is resulted that the growth characters of pea indicated significant effect of sowing dates as sowing dates, D_1 (1st November) had recorded maximum plant height, number of leaves, number of branches, earliest 50% flowering and harvesting and SPAD value at all the growth stages, while minimum in D_4 (16th December) date of sowing. Yield attributes traits revealed significant impact of date of sowing in garden pea. Highest number of pods per plant was recorded under D_1 (1st November), D_2, D_3 and D_4. Sowing dates exhibited significant effect on pod length and number of seed per pod. Minimum harvest index was observed under D_4 (16th December). Results showed significant influence of sowing dates on seed germination percentage, weight of 100 seed (g) and seed vigour index in pea. Maximum weight of 100 seed (g) was noted in case of D_1 (1st November which was significantly higher than D_3>D_4. While minimum weight of 100 seed (g) was recorded under D_4. Maximum germination percentage was observed under D_1 (1st November) which was followed by D_2 >D_3> D_4 while minimum germination (%) was recorded with D_4. Maximum seed vigour was recorded with D_1 (1st November) which was significantly superior over other dates of sowing. Highest number of pods per plant, harvest index, seed yield per plant (g) and seed yield per hectare was found with variety V_7. Highest seed yield per plant (g) and seed yield per hectare was recorded with variety V_7. Maximum pod length and number of seed per pod was found with V_3 which was significantly superior over all other varieties. Quality traits of pea significantly influenced sowing dates on seed germination percentage, weight of 100 seed (g) and seed vigour index which were maximum with variety V_7 (Kashi Samarth), while lowest were observed in case of variety V_6 (Arka Ajit).

Introduction

Pea (*Pisum sativum* L.), is being recognized as an important protein supplement vegetable crop. Pea is highly nutritive and contains digestible protein (7.2 g), carbohydrate (15.8 g), vitamin-C (9 mg), phosphorus (139 mg) per 100 (g) of edible portion (Gopalakrishnan, 2007). Fresh seed and pea pods can be used as a fresh vegetable or consumed as a frozen product. Dry seeds are used as pulse for human consumption.

Early cultivation of pea was for pulse purpose and mostly round seeded varieties were grown mainly as a rainfed crop. The vegetable pea

varieties are sweet in taste and hence are mostly wrinkled or dimpled because of high sugar content.

Pea cultivation is widespread in areas having a mild and warm climate, because relatively high or low temperatures are the most important factors limiting pea cultivation. A dry climate is also unsuitable for the plant, particularly during flowering and pod development. Cumulative mean temperature requirements for floral initiation varied and this data could be used to decide sowing dates for different cultivars. Yield can be increased by early sowing and with the use of the seeds of early flowering and maturing cultivars. However, another important factor determining the sowing time and cultivar is the required product (Bozoglu *et al.,* 2007)

Peas are sown in *Rabi* season from beginning of October to the end of November in northern plains as the cool climate of about four months is ideal for pea growing. The areas where there is slow transition from cool to warm weather are ideal for pea growing. The optimum temperature for seed germination is about 22^{o}C however, it can germinate up to 5^{o}C but at slow rate. Peas grow best at mean temperature of 13-18^{o}C. It is tolerant to frost at early stage of growth. At later stage, the flowers and pods are affected. The wrinkled seeded cultivars are more sensitive to high temperature and a temperature of 30^{o}C and above even for a day affects the quality of pods. Since the seed crop of garden pea remains in the field for a longer duration, it is very much affected by the sowing time (Singh and Singh, 2011).

Seed yield is affected very much by environmental factors prevailing at the time of seed development. Even at the same location seed yield of early, mid or late maturing pea crops is different because of varying environmental conditions at the time of pod maturity. It is evident from the study that the pea cultivars differ in their yield potential and adaptability to various climatic conditions (Amjad and Anjum, 2002).

Malwa region of Madhya Pradesh is not a traditional area of pea cultivation. But now days with increasing urbanization and growing awareness for vegetable consumption, demand for pea is increasing. Hence, there is a need to enhance the availability of pea by increasing the pea cultivation which requires supply of good quality seed of suitable varieties. Keeping above facts in view, an experiment was carried out to study the effect of date of sowing and varieties on growth, yield and quality of seed in pea.

Materials and Methods

A field experiment entitled 'Assessment of sowing dates and varieties on growth, yield and quality of seed in garden pea (*Pisum sativum* L.)' was conducted at Research Field Department of Vegetable Science, College of Horticulture, Mandsaur, RVSKVV, Gwalior (M.P.) during *Rabi* season in 2014-15. Twenty eight treatment combinations comprising of four different sowing dates *viz.,* (D_1: 1st November, D_2:16th November, D_3:1st December, D_4:16th December) and seven varieties *viz.,* (V_1: Arkel, V_2: Azad Pea-3, V_3: Pusa Pragati, V_4: Kashi Nandini, V_5: Mater Ageta-6, V_6: Arka Ajit and V_7: Kashi Samarth) were taken under study to estimate response in growth and yield of garden pea (Fig. 1 and 2). The physical and chemical composition of the experimental soil also have been calculated and given in (Table 1). Nitrogen, phosphorus and potash were applied at the rate of 50:90:50 kg/ha, respectively, seed was sown in lines at a spacing of 30 x 10 cm and covered with soil. Seeds were sown at a depth of 3-4 cm. before sowing; seed was treated with mancozeb + carbendazim @ 2+1g per kg seed. The applications of thimet,

dimethoate 30% EC (1.5ml/litre), chlorpyrifos 20% EC (2ml/l) + Neem oil (5ml/l) were done to control the insect pests. Prophylactic spray of mancozeb 75% WP (2g/l) and carbendazim (1g/l) was done to check the diseases. Five plants were randomly selected and tagged from each treatment under each replication excluding the border plants. Observation data were recorded on the tagged plants for the growth, yield and quality attributes of garden pea. The data obtained on various observations for each treatment were subject to 'Analysis of variance' as recommended by Panse and Sukhatme (1985).

Results and Discussion

Growth parameters

Growth attributes of garden pea *viz.*, plant height, and number of branches, number of leaves, SPAD value, days to 50% flowering and days to harvesting were recorded during the present investigation. There was significant effect of varieties and sowing dates on all the stages of growth and parameters (Table 2).

It is resulted the sowing dates D_1 (1st November) has noticed maximum plant height, number of branches number of leaves, SPAD value, earliest 50 % flowering and harvesting at all the growth stages, while minimum sowing dates was recorded in D_4 (16th December). Relatively favourable temperature and longer time available for the growth and development under earlier sowing could have promoted the growth of the plants which consequently resulted in early flowering and lesser days to harvesting. Whereas, last date of sowing was followed by low temperature which slow down the growth and consequently took more days for 50% flowering and harvesting. Similar results were reported by Bozoglu *et al.*, (2007) and Singh and Singh (2011).

There were significant differences among varieties for growth attributes under the experiment. Maximum plant height was found in variety V_7 (Kashi Samarth) at all the three growth stages (30, 45 and 60 days after sowing), followed by V_6 (Arka Ajit), V_3 (Pusa Pragati), V_2 (Azad Pea-3), V_4 (Kashi Nandini) and V_5 (Mater Ageta-6) in descending order at all the stages under study. Minimum plant height was recorded in case of V_1 (Arkel). These differences in plant height of different varieties could be attributed to their genetic makeup and adaptability to prevailing environmental conditions. These findings are in line with Amjad and Anjum (2002) and Kalloo *et al.*, (2005).

Variety V_7 (Kashi Samarth) recorded maximum number of branches per plant at all the stages followed by V_3 (Pusa Pragati), V_2 (Azad Pea-3). Minimum number of branches was found with V_6 (Arka Ajit). These variations among varieties may be governed by their genetic makeup. Similar findings have been reported by Shaukat *et al.*, (2012) and Tiwari *et al.*, (2014). Maximum number of leaves per plant were found under variety V_7 (Kashi Samarth) followed by V_3 (Pusa Pragati). Minimum number of leaves was recorded with V_6 (Arka Ajit). Higher number of branches might have lead to higher number of leaves. These findings are in accordance to those obtained by Ashraf *et al.*, (2011) and Singh and Singh (2011).

Among the varieties, maximum SPAD value was found with variety V_7 (Kashi Samarth) followed by V_3 (Pusa Pragati).While, lowest SPAD value was determined under V_6 (Arka Ajit). Higher SPAD value under these varieties might be the result of favourable interaction effect of environmental conditions and their genotype. Variety V_6 (Arka Ajit) had taken maximum days to 50% flowering after sowing followed by V_7 (Kashi Samarth), V_3 (Pusa Pragati). The difference between V_2, V_3,

V_6 and V_7 was non-significant. Minimum days to 50% flowering after sowing were taken by variety V_5 (Mater Ageta-6). These findings are in agreement with Sharma *et al.*, (2013). Variety V_6 (Arka Ajit) had taken maximum days to harvesting after sowing, followed by V_7 (Kashi Samarth).

The difference between V_6, V_7 and V_3 was non-significant. Minimum days to harvesting after sowing were taken by variety V_5 (Mater Ageta-6). Delayed commencement of 50% flowering might have been the reason for late maturity consequently number of days to harvesting. Similar findings were also observed by Amjad and Anjum (2002).

Yield parameters and yield

Yield attributes *viz.*, number of pod per plant, pod length, number of seed per pod, shelling percentage, seed yield per plant (g), seed yield per hectare and harvest index were recorded to evaluate the impact of different varieties and date of sowing in garden pea (Table 3a, b, c, d). There was decrease in number of pods per plant with each delay in sowing. Highest number of pods per plant was recorded under D_1 (1st November), followed by D_2, D_3 and D_4. The difference between D_1 and D_2 was non-significant. The earlier sowing provided more period for growth and development which consequently resulted in more number of pod per plant. Similar findings have been reported by Munakamwe *et al.*, (2012) and Shaukat *et al.*, (2012).

Sowing dates exerted remarkable influence on pod length and number of seed per pod. There was linear decrease in pod length with every delayed sowing. Maximum length of pod and number of seed per pod was recorded with D_1 (1st November) which was followed by D_2, D_3 and D_4. Sowing dates D_2, D_3 and D_4 were at par to each other. In early sowing the temperature was optimum for plant growth and development which resulted in vigorous plants with long pods due to which more number of seeds per pod. These results are in agreement to the findings obtained by Munakamwe *et al.*, (2012), Shaukat *et al.*, (2012) and Tiwari *et al.*, (2014).

There was decrease in shelling percentage with each delay in sowing. Highest shelling percentage was recorded under D_1 (1st November). It was followed by D_2, D_3 and D_4 in descending order. Lowest shelling percentage was recorded under D_4 (16th November). The difference between D_1 and D_2 was non-significant. These findings are in line with those reported by Tiwari *et al.*, (2014).

Table.1 Physical and chemical composition of the experimental soil

S. No.	Composition			Methods
	Physical	**Content**	**Category**	
1.	Sand %	55	-	**Bouyoucos Hydrometer**
2.	Silt %	35	-	**Bouyoucos Hydrometer**
3.	Clay %	10	-	**Bouyoucos Hydrometer**
	Chemical	**Content**	**Category**	
4.	Soil pH	7.08	Neutral	**Glass electrode pH meter**
5.	Electrical conductivity (dSm^{-1})	0.33	Normal	**By conductivity bridge at 25^0C**
6.	Available nitrogen (kg/ha)	317.00	Medium	**Rapid titration method (Walkley and Black,1934)**
7.	Available phosphorus (kg/ha)	19.30	Medium	**Olson's extraction method (Olson *et al.*, 1954)**
8.	**Available potassium (kg/ha)**	**694.00**	**High**	**Flame photometer (Ghosh *et al.*, 1981)**

Table.2 Effect of different sowing dates and varieties in growth parameters of garden pea

Treatment	Plant height (cm)			Number of branches of per plant			Number of leaves per plant			SPAD value		
	30DAT	45 DAT	60 DAT	30DAT	45 DAT	60 DAT	30DAT	45 DAT	60 DAT	30DAT	45 DAT	60 DAT
Date of Sowing												
D_1	29.27	34.06	57.66	3.99	6.60	9.15	25.73	48.38	53.55	51.10	50.76	**50.95**
D_2	27.46	32.70	52.18	3.58	5.82	7.54	22.23	44.97	52.46	50.01	48.33	**49.42**
D_3	27.42	32.31	40.88	3.51	5.57	6.83	17.60	38.02	47.17	42.47	46.02	**47.30**
D_4	26.94	32.12	40.42	3.43	5.70	6.77	17.55	37.04	45.90	32.48	44.57	**45.45**
S.Em ±	0.50	0.52	1.37	0.11	0.19	0.21	0.70	0.99	0.65	1.50	1.56	**1.41**
$CD_{5\%}$	1.42	1.48	3.88	0.34	0.56	0.60	2.01	2.81	1.85	4.25	4.43	**4.01**
Varieties												
V_1	23.21	30.18	42.43	3.57	5.73	7.59	20.50	42.46	49.58	43.59	47.41	**48.83**
V_2	28.16	32.86	46.21	3.88	6.06	8.02	21.67	43.37	50.13	45.30	48.34	**49.63**
V_3	28.77	33.28	47.65	4.14	6.40	8.17	22.59	44.33	51.78	45.62	50.28	**52.92**
V_4	27.15	32.15	45.22	3.21	5.63	7.36	19.83	41.42	49.17	41.93	46.28	**45.24**
V_5	25.93	31.90	44.65	3.08	5.32	7.02	18.56	40.31	47.76	41.18	44.60	**44.58**
V_6	29.38	34.16	50.77	2.97	5.44	6.31	16.98	36.63	46.12	38.25	41.04	**42.57**
V_7	31.80	35.05	57.56	4.55	6.88	8.55	25.30	46.21	53.87	52.21	53.98	**54.18**
S.Em ±	0.66	0.69	1.81	0.15	0.26	0.28	0.93	1.31	0.86	1.98	2.06	**1.87**
$CD_{5\%}$	**1.88**	**1.93**	**5.14**	**0.44**	**0.74**	**0.79**	**2.66**	**3.72**	**2.44**	**5.63**	**5.86**	**5.31**

Table.3 (a) Effect of different sowing dates and varieties in yield attributes traits of garden pea

Treatments	Number of pod per plant					Pod length (cm)					Number of seeds per pod				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
V_1	17.87	17.17	16.63	16.47	17.03	6.73	6.13	6.10	6.00	6.24	5.97	5.93	5.60	5.17	5.67
V_2	17.60	16.93	16.63	16.17	16.83	7.03	6.47	6.63	6.60	6.68	6.20	6.13	6.10	5.97	6.10
V_3	17.40	16.80	15.67	15.10	16.24	8.43	8.17	8.63	8.23	8.37	7.37	7.20	7.17	7.07	7.20
V_4	17.90	17.20	16.93	16.80	17.21	6.87	6.30	6.40	6.23	6.45	6.13	6.07	6.03	5.50	5.93
V_5	18.13	17.93	16.93	16.83	17.46	6.20	6.07	5.70	5.90	5.97	5.53	5.33	5.07	4.43	5.09
V_6	16.73	16.53	15.17	13.57	15.50	7.50	7.30	6.67	6.67	7.03	6.43	6.37	6.20	6.17	6.29
V_7	19.07	18.33	18.20	18.17	18.44	6.80	6.20	6.33	6.10	6.36	6.10	6.03	5.93	5.37	5.86
Mean	17.81	17.27	16.60	16.16		7.08	6.66	6.64	6.53		6.25	6.15	6.01	5.67	

Treatment	S.Em ±	$CD\ at_{5\%}$
Sowing dates	0.33	0.94
Varieties	0.44	1.25
Interaction	0.88	NS

Treatment	S.Em ±	$CD\ at_{5\%}$
Sowing dates	0.14	0.40
Varieties	0.18	0.52
Interaction	0.36	NS

Treatment	S.Em ±	$CD\ at_{5\%}$
Sowing dates	0.14	0.39
Varieties	0.18	0.52
Interaction	0.37	NS

Table.3 (b) Effect of different sowing dates and varieties in yield attributes traits of garden pea

Treat.	Shelling percentage					Seed yield per plant (g)					Seed yield per hectare (q)				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
V_1	60.45	58.33	55.39	52.21	56.59	15.67	15.23	14.43	13.76	14.77	20.62	16.66	14.00	13.70	16.24
V_2	64.31	61.90	59.37	57.93	60.88	16.07	15.77	15.63	14.07	15.39	22.43	18.44	17.16	15.32	18.34
V_3	63.63	61.56	57.17	56.18	59.64	17.23	16.30	16.20	15.40	16.28	35.81	24.82	24.18	19.93	26.19
V_4	64.93	62.97	61.37	61.37	62.66	16.40	16.20	16.10	15.83	16.13	32.45	23.87	19.90	19.75	23.99
V_5	69.50	68.56	65.96	62.22	66.56	16.33	16.03	16.00	15.67	16.01	25.31	23.51	19.14	18.88	21.71
V_6	63.06	59.98	56.59	55.44	58.77	16.27	16.00	15.83	15.57	15.92	24.77	20.31	18.72	17.82	20.40
V_7	67.59	64.58	64.29	61.78	64.56	17.93	17.90	17.20	15.83	17.22	40.05	27.56	25.59	25.33	29.63
Mean	64.78	62.55	60.02	58.16		16.56	16.21	15.91	15.16		28.78	22.16	19.81	18.68	
Treatment	**S. Em ±**	**CD at 5%**				**Treatment**	**S.Em ±**	**CD at 5%**			**Treatment**	**S.Em ±**	**CD at 5%**		
Sowing dates	**1.11**	**3.14**				Sowing dates	0.26	0.74			Sowing dates	0.77	2.17		
Varieties	**1.46**	**4.15**				Varieties	0.35	0.98			Varieties	1.01	2.88		
Interaction	**2.93**	**NS**				Interaction	0.69	**NS**			Interaction	2.03	**NS**		

Table.3 (c) Effect of different sowing dates and varieties in yield attributes traits of garden pea

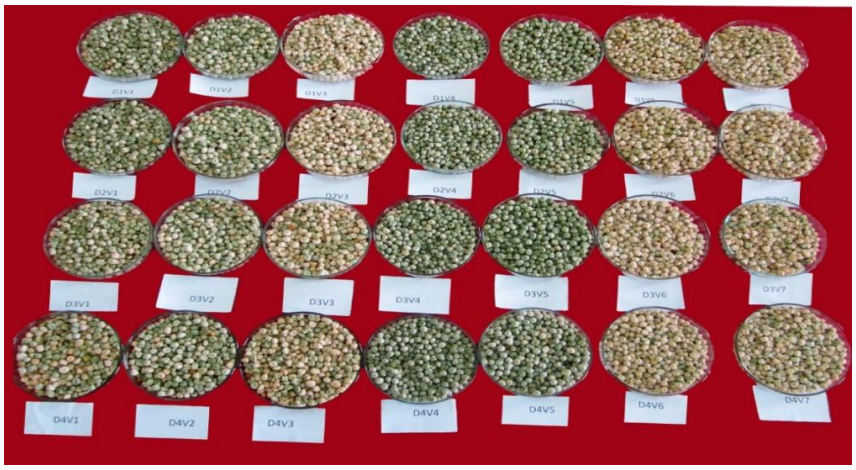
Treat.	Harvest index					Weight of 100 seed (g)					Germination percentage				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
V_1	38.87	38.33	38.20	35.20	37.65	17.56	17.43	16.94	16.18	17.03	96.33	94.67	93.33	91.00	93.83
V_2	34.93	32.23	31.57	29.97	32.18	16.92	16.56	15.83	15.82	16.28	95.70	94.33	92.67	90.33	93.26
V_3	35.40	36.17	33.20	29.00	33.44	17.98	17.85	17.63	16.45	17.48	97.00	95.33	94.33	91.03	94.43
V_4	37.53	37.00	36.33	35.53	36.60	16.27	16.25	15.69	15.58	15.95	95.67	93.33	91.50	90.00	92.63
V_5	41.20	40.33	36.20	35.70	38.36	16.03	15.97	15.39	15.29	15.67	94.33	93.00	91.33	89.00	91.92
V_6	35.10	33.27	29.97	29.53	31.97	15.68	14.08	12.96	12.49	13.80	93.33	91.33	88.00	84.33	89.25
V_7	45.83	43.20	40.40	35.10	41.13	19.30	19.22	18.38	17.23	18.53	97.67	96.33	94.67	93.67	95.58
Mean	38.41	37.22	35.12	32.86		17.11	16.77	16.12	15.58		95.72	94.05	92.26	89.91	
Treatment	**S.Em ±**	**CD at 5%**				**Treatment**	**S.Em ±**	**CD at 5%**			**Treatment**	**S.Em ±**	**CD at 5%**		
Sowing dates	**0.57**	**1.63**				Sowing dates	0.32	0.91			Sowing dates	1.72	2.03		
Varieties	**0.76**	**2.16**				Varieties	0.43	1.21			Varieties	0.95	2.69		
Interaction	**1.52**	**NS**				Interaction	0.85	**NS**			Interaction	1.90	**NS**		

Table.3 (d) Effect of different sowing dates and varieties in yield attributes traits of garden pea

Treat.	Seed Vigour of pea				
	D_1	D_2	D_3	D_4	Mean
V_1	13176.67	10757.07	8045.33	6723.90	9675.74
V_2	12054.00	10384.00	7976.40	6565.53	9244.98
V_3	14648.00	11997.33	8241.40	7650.00	10634.18
V_4	11833.47	8619.30	7100.00	6116.00	8417.19
V_5	11573.33	8554.00	6882.12	4573.33	7895.70
V_6	10981.33	8536.00	6775.00	4528.00	7705.08
V_7	15040.67	12829.33	8938.93	8752.93	11390.47
Mean	12758.21	10239.58	7708.46	6415.67	
Treatment	S.Em ±	CD at$_{5\%}$			
Sowing dates	155.28	440.28			
Varieties	205.42	582.40			
Interaction	410.84	NS			

Fig.1 Seeds of different varieties of garden pea

Fig.2 Seeds of garden pea in combination of different date of sowing and varieties



Sowing date exhibited significant influence on seed yield per plant and seed yield per hectare. There was decrease in seed yield per plant and seed yield per hectare with each delayed sowing. Maximum seed yield per plant and seed yield per hectare was recorded with D_1 (1st November) which was higher than D_2 >D_3> D_4 sowing dates under study. Favourable effect of earlier sowings on growth and development of pea plants encouraged higher growth and yield attributes which ultimately resulted in higher yield. These findings are corroborated with those reported by Singh and Singh (2011), Munakamwe *et al.,* (2012), Shaukat *et al.,* (2012) and Tiwari *et al.,* (2014).

There was decrease in harvest index with each delayed sowing. Highest harvest index was recorded under D_1 (1st November) which was superior over other sowing dates. Minimum harvest index was observed under D_4 (16th December). Harvest index under D_1 and D_2 were at par to each other. Earlier dates of sowing provided more time for growth and development resulting in proper translocation of food material to pod and seeds. Later sowing had lesser time for growth and development thereby might have been forced maturity which could have insufficient development of seed resulting in lower harvest index. Similar findings have been reported by Siddique *et al.,* (2002) and Munakamwe *et al.,* (2012).

Amongst the varieties, highest number of pods per plant was found with variety V_7, which was followed by V_5, V_4, V_1, V_2 and V_3. Lowest number of pods per plant was observed in case of variety V_6. These differences in varieties for number of pods could be ascribed to their genetic makeup as well as favourable effect of environment which promoted growth as well as more number of pods. Similar findings have been reported by Sharma *et al.,* (2013) and Uddin *et al.,* (2014). Pod length and number of seed per pod indicated significant effect of varieties. Maximum pod length and number of seed per pod was found with V_3 which was significantly superior over all other varieties. Minimum pod length and number of seed per pod was observed in case of variety V_5.This variation might be due to the inherent potential of cultivar and their interaction with climatic condition. The number of seed in a pod is variable depending upon the cultivar. These findings are supported with those obtained by Ashraf *et al.,* (2011) and Sharma *et al.,* (2011). Highest shelling percentage was found with variety V_5, While lowest shelling percentage was observed in case of variety V_1 (Arkel). The difference between V_4, V_5 and V_7 was non-significant. These results showed higher food material translocation efficiency of variety V_5. These findings are in agreement with Kumari *et al.,* (2008) and Sharma *et al.,* (2011).Highest seed yield per plant (g) and seed yield per hectare was found with variety V_7, which was at par to V_3 but significantly superior over all other varieties. Similar findings have been reported by Sharma *et al.,* (2013) and Uddin *et al.,* (2014). Variety V_7 (Kashi Samarth) registered maximum harvest index which was superior over all other varieties.

Quality parameters

Quality of pea seed was studied with respect to germination percentage, weight of 100 seed (g) and seed vigour index. Results showed significant influence of sowing dates on seed germination percentage, weight of 100 seed (g) and seed vigour index in pea (Table 3a, b, c, d). Sowing date exerted significant effect on weight of 100 seed. There was decrease in weight of 100 seed (g) with each delayed sowing. Maximum weight of 100 seed (g) was recorded with D_1 (1st November which was significantly higher than D_3> D_4. While minimum weight of 100 seed (g) was

recorded under D_4. Among the date of sowing, D_1 and D_2 were at par to each other. These findings are in agreement with Bozoglu *et al.*, (2007) and Singh and Singh (2011). Germination percentage indicated significant effect of sowing dates in pea. There was decrease in germination percentage with each delayed sowing. Maximum germination percentage was recorded with D_1 (1^{st} November) which was followed by D_2 >D_3> D_4 sowing dates under study while minimum was recorded under D_4.

The difference between D_1 and D_2 was non-significant. Similar results were found by Singh and Singh (2011) and Shaukat *et al.*, (2012). Seed vigour was influenced significantly with sowing dates. There was decrease in seed vigour with each delayed sowing. Maximum seed vigour was recorded with D_1 (1^{st} November) which was significant superior over other dates of sowing under study. It was followed by D_2 >D_3> D_4 descending order. All the dates of sowing differed significantly to each other with respect to seed vigour under study. Castillo *et al.*, (2010) had also found significant effect of sowing date on seed vigour in pea.

Among the varieties, maximum weight of 100 (g) seed was found in variety V_7. These results are in accordance with those reported by Ashraf *et al.*, (2011), Sharma *et al.*, (2013) and Uddin *et al.*, (2014). Maximum germination percentage was found with variety V_7. Lowest germination percentage was observed in case of variety V_6. Among the varieties, maximum seed vigour was found in variety V_7 which was significantly superior over other dates of sowing under experiment, followed by V_3. Lowest seed vigour was observed in case of variety V_6. Higher germination (%) and 100 seed weight resulting from better genetic makeup and growth and development of plant may be the reason for superiority for seed vigour. Similar results were also reported by Kumari *et al.*, (2008) and Ashraf *et al.*, (2011).

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