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RESEARCH ARTICLE Legume Research- An International Journal, Volume Issue : ()

Effect of Sowing Dates on Phenological Traits, Yield and its Contributing Attributes on Snow Pea Genotypes

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ABSTRACT

Background: Precise knowledge of sowing date of a particular variety at a specific location is critical to achieve high yield. Keeping this in view, experiment was planned to assess the response of snow pea genotypes for sowing dates.

Methods: Four genotypes namely, DPEPP-15-1, DPEPP-10-1, Arka Apoorva and Mithi Phali were sown on three sowing dates (21st October, 5th November and 20th November) in split plot design, replicated thrice at Palampur during winter 2018-19 and 2019-20 and observations were recorded on different yield attributes.

Result: Early sown pea (21st October) resulted in early flowering and first picking, higher pod yield, pods/plant and harvest duration followed by 5th November sown crop. DPEPP-10-1 showed significantly superior performance for early harvest while DPEPP-15-1 was the most promising genotype followed by DPEPP-10-1 for yield and its contributing parameters. Genotypes DPEPP-15-1 and DPEPP-10-1 had advantage of 36 and 27% for fresh yield over variety Arka Apoorva respectively. Interaction between sowing dates and varieties revealed that sowing of DPEPP-15-1 on 21st October followed by 5th November had significantly higher pod yield, pods/plant and harvest duration followed by DPEPP-10-1 and they significantly outperformed other varieties Arka Apoorva and Mithi Phali.

Key words: Edible podded pea, Genotypes, Phenological traits, Sowing dates, Yield traits.

INTRODUCTION

Edible podded peas are popular cool season exotic vegetables and comprise of snow and sugar snap pea. They share cultivation pattern with commonly grown garden pea. It is popular as snow pea in the USA and Australia and as 'mange-tout' in England and France which means 'eat-all'. Plump pods with partly developed seeds can be eaten usually by removing the filaments (like thread, fibrous) along the edges of pods as salad, lightly boiled, steamed or used as 'mingled fry' and soups/stews. Pods are slightly flavoured, sweet, crispy, lacking pod parchment (Chauhan *et al.* 2021). In Asian countries, shoots of plants are also used in cooking. Snow pea has its significance as a short duration crop with high yield and high value produce, hence it may be a good alternative for small and marginal farmers. Moreover, it could increase farm profitability by providing diversity in produce as specialty crop interest to direct market consumers. It requires persistent harvesting and therefore, demands intensive use of labour which may be one of the restraints for extensive production (Sharma 2020). It is recently introduced crop in India (Chauhan and Sharma 2021) and as of now, there are no final figures available for its cultivation. However, its popularity is gaining in India with tremendous scope in the niche and up markets along with its potential as export and processed vegetable. In Indian plains, the crop is normally sown in late autumn and ready for harvest in early spring. Agroclimatic conditions of Himachal Pradesh favour its cultivation throughout the year as an off-season crop just like garden pea and thus, it has the ability to provide handsome returns to the growers.

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Snow pea can be grown in diverse agroclimatic conditions but favours cool and moist growing conditions for getting optimum yield and quality produce. Drought, frost and high temperature (>30°C) have adverse effect on yield vis-à-vis quality while growth is adversely affected below temperature 10°C. Occurrence of frost, especially at flowering and pod formation stages, is quite damaging as it reduces fertility that results in no or poor pod formation and also damages the developing pods. Therefore, the choice of sowing date is an important management option to optimize pod yield under such abnormal environmental conditions (Sharma *et al.* 2014). Time of sowing is known to influence the establishment of the pea crop, growth and development of the seeds and also the environment

experienced during seed development, both within and above the crop canopy. It is known that high temperature during seed development increases the incidence of hollow heart, thereby lowering seed quality.

The selection of an appropriate variety is a key management component in any cropping system, even more critical than any other agronomic practices in pea production. The development of new varieties is a key component to be taken up with an objective to surpass the potential of commercial adopted varieties *vis-a-vis* desirable pod characteristics. Numerous publications in garden pea have reported enhanced pod yield with early sowing and a reduction in yield with delayed sowing after the optimum time (Mukherjee *et al.* 2013; Sharma *et al.* 2014; Tiwari *et al.* 2014; Sirwaiya *et al.* 2018). Precise knowledge of sowing date of a particular variety at a specific location is critical to achieve a high pod yield. Keeping these aspects in view, it would be imperative to study the effect of different sowing dates on the performance of different genotypes of snap pea to harness better growth and potential pod yield.

MATERIALS AND METHODS

The present investigation was carried out at the Vegetable Research Farm, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during winter season of 2018-19 and 2019-20, to evaluate the response of 4 edible podded pea genotypes namely, DPEPP-15-1 (Him Palam Meethi Phali-1), DPEPP-10-1 (Him Palam Meethi Phali-2), Mithi Phali and Arka Apoorva to different sowing dates (21st October, 5th November and 20th November) in split plot design with three replications in a plot size of 2.7 m × 1.8 m at a spacing of 45 cm between rows and 7.5 cm with in row. The dates of sowing were accommodated in main plots and four varieties in sub plots. The Research Farm is situated at an elevation of 1290 m amsl at 32° 6′ N latitude and 76° 3″ E longitude which represent mid hill zone of Himachal Pradesh with humid temperate climate (mild summers and cool winters). The average annual rainfall ranges from 2000-2500 mm, about 75-80% of which is received during monsoon period from June-September. The soils are classified as Alfisol, sub-group Typic Hapludalf clay with a pH of 5.7 *i.e.* acidic in reaction, CEC from 9.0 to 13.0 mg/100 g soils, medium to high in organic carbon, medium in available N and P and high in available K.

The standard plant protection and other cultural practices used to raise garden pea that were followed to raise snow pea crop. The chemical fertilizers @ 40 kg N, 60 kg P_2O_5 and 30 kg K_2O per ha^{-1} were applied as basal dose through urea, single super phosphate and muriate of potash, respectively. The herbicide pendimethalin 1.2 kg a.i./ha was applied as pre-emergence followed by three hand weeding at monthly interval to manage the weeds. Four irrigations were applied uniformly in all the treatments during the cropping period.

The observations were recorded for phenological traits namely, days to 50% flowering, first picking and seed maturity; yield and its contributing traits namely, pod length (cm), pod width (cm), seeds/pod (number), average pod weight (g), pods/plant (number), pod yield (g/plant and t/ha) and harvest duration (days). The total pod yield on hectare basis was calculated in tonnes by multiplying with the factor 0.0037 which was computed by dividing one hectare (10% of the area accounted for paths and channels) with plot size. Total number of days from first picking to final pod picking were counted to work out harvest duration in days. The analysis of variance was done for all the traits as per the method given by Gomez and Gomez (1982).

RESULTS AND DISCUSSION

Effects of sowing dates

Earliness is one of the most desirable traits in vegetable crops since prices of produce are in general higher in the beginning of the crop season. Earliness in pea is determined by days to 50% flowering and days to first picking. The scrutiny of data presented in Table 1 revealed that 21st October sowing took significantly lowest number of days to 50% flowering and days to first picking over other dates of sowing (5th November and 20th November) during both the years as well as on pooled basis. Similarly, sowing on 5th November flowered early during the second year (2019-20) and on pooled basis though it was at par with 20th November sowing during first year of study. Singh and Singh (2011) and Sirwaiya and Kushwah (2018) had also reported delayed flowering and first picking with late sowings. Minimum number of days taken to flowering and first picking in early sowing dates was due to more favourable growing conditions in the initial growth stages. It is relevant to mention that the difference for days to 50% flowering between first and second date of sowing varied from 15-19 days while it was only 2-3 days between second and third sowing date in the respective years but the difference between first two sowing dates for first picking reduced only to four days which may be due to the prevailing favourable temperature and day length for pod formation and development from February onwards. The flowering in early sown crop coincided with chill temperature in December and January which might have affected fertilisation and pod formation and hence the first picking in both the dates of sowing were obtained almost at the same time. Sharma *et al.* (2014) had also reported reduction in number of days to first picking in comparison to number of days to 50% flowering in garden pea.

Sowing on 21st October took significantly more numbers of days to seed maturity followed by 5th November and 20th November sown crop in that order each date differing significantly from one another. A declining trend was observed for seed maturity with delay in sowing from 21st October to 20th November and the difference of about 5 to 6 days between first and second sowing date was further reduced to about 4 weeks in late sown crop as compared to early sown crop. This indicated that late sown crop matured about 4 weeks earlier than early sown crop over the years and ultimately led to seed harvest almost parallel to other

Table 1: Effect of dates of sowing on phenological traits of different snow pea varieties.

Treatment	Days to 50% flowering			Days to first picking			Days to seed maturity		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018- 19	2019- 20	Pooled
Date of sowing (D)									
21st October	83.08	82.92	83.00	115.17	110.92	113.05	173.25	179.67	176.46
5th November	101.67	97.83	99.75	119.33	115.00	117.17	167.00	175.00	171.00
20th November	103.58	100.83	102.21	125.25	120.67	122.96	144.25	154.17	149.21
SEm±	1.04	0.42	0.60	0.51	1.07	0.59	0.49	1.00	0.56
CD (P≤0.05)	4.10	1.65	1.97	2.02	4.21	1.94	1.91	3.92	1.81
Varieties (V)									
DPEPP-15-1 (Him Palam Meethi Phali-1)	92.56	90.11	91.34	118.89	114.00	116.45	164.33	172.67	168.50
DPEPP-10-1 (Him Palam Meethi Phali-2)	91.11	88.00	89.56	115.67	112.44	114.06	162.33	170.89	166.61
Mithi Phali	101.44	99.22	100.33	123.56	118.56	121.06	158.67	168.33	163.50
Arka Apoorva	99.33	98.11	98.72	121.56	117.11	119.34	160.67	166.56	163.61
SEm±	0.64	0.57	0.48	0.85	0.47	0.48	0.99	0.68	0.60
CD (P ≤ 0.05)	1.89	1.69	1.38	2.53	1.39	1.39	2.93	2.03	1.72
Interaction D × V	S	S	S	NS	NS	NS	NS	NS	NS

Where' S- Significant and NS- Non significant.

sowing dates in the same month *i.e.,* April. The reduction in number of days to seed maturity was due to availability of shorter cool growing period for the delayed sown crop and simultaneous rise in temperature which accelerated the developmental stages of the crop and thereby caused senescence almost in the same month of April in all sowing dates.

Significant influence of dates of sowing on average pod weight, pods/plant and pod yield over the years was also recorded (Table 2). During the first year as well as on pooled basis the crop sown on 5th November resulted in significantly higher average pod weight (4.02 g) while during the second year 21st October sowing recorded higher average pod weight (4.02 g) which incrementally decreased with sowing on 5th November and 20th November, respectively. Variable performance of garden pea under different sowing dates had also been reported by Waheed *et al.* (2015). In general, better performance of pod attributes namely, pod length, pod width, seeds/pod and average pod weight were recorded in early and mid-sown crop which might be the result of favourable climatic conditions. Significantly higher pods/plant and pod yield/plant was recorded in 21st October sowing which declined with delayed sowing with significantly lowest values of these parameters recorded with 20th November sowing. The decrease in pod number in delayed sowing seems to be associated with poor initial growth of the plant whereas favourable weather conditions throughout the growing season resulted in maximum pod number in early sown crop. Ali *et al.* (2016) also had reported reduction in pod number with delayed sowing.

Significantly higher pod yield during both the years of study as well as on pooled basis was recorded from the crop sown on 21st October which was followed by 5th November sowing and 20th November sowing in that order each date differing significantly except during first year where the two early dates were at par with each other. The highest yield recorded with 21st October sowing was due to significantly higher average pod weight, pods/plant and harvest duration. The lowest yield recorded during last date of sowing on 20th November was due to the lowest value of yield contributing attributes which may be the result of the least time taken to flowering and pod development. High temperature during later part of the plant growth caused forced maturity of the crop that in turn produced low pod yield.

Long harvest duration has unswerving direct relevance in enhancing total pod yield. It provides continuous supply of produce and therefore, help in harnessing off-season advantage for a long period by continuous supply to the market. Early sowing on 21st October resulted in significantly longest harvest duration during both the years of study. The reduction in harvest duration with delayed sowing of snow pea was due to availability of shorter cool growing period which cause reduction in number of days to complete vegetative state and hasten the developmental stages of the crops and thereby shorten the harvest duration. Jiaojiao *et al.* (2013) had also reported that early sowing in pea have long harvest duration over late sown crop.

Varieties

Varieties differed significantly for days to 50% flowering and days to first picking. DPEPP-10-1, remaining at par with DPEPP-15-1 (Table 1), took significantly lower days to 50% flowering and days to first picking while Mithi Phali took

Table 2: Effect of dates of sowing on yield and related traits of different snow pea varieties.

Treatment	Pod length (cm)			Pod width (cm)			Seeds/pod (No.)			Pod weight (g)			Pods/plant (number)			Pod yield (g/plant)			Pod yield (t/ha)			Harvest duration (days)		
	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool	2018-19	2019-20	Pool
Date of sowing (D)																								
21st October	10.40	10.92	10.66	1.98	2.04	2.01	6.68	7.68	7.18	3.45	4.02	3.73	12.56	15.98	14.27	43.59	65.10	54.34	9.92	15.54	12.73	43.08	53.33	48.21
5th November	9.82	10.37	10.09	1.98	2.05	2.01	6.44	7.45	6.95	4.02	3.75	3.88	10.09	13.29	11.69	40.64	50.17	45.40	9.82	12.35	11.09	35.58	42.67	39.13
20th November	9.79	9.99	9.89	1.94	1.98	1.96	6.31	7.23	6.77	3.61	3.49	3.55	7.36	10.42	8.89	26.78	36.69	31.74	6.37	9.28	7.83	19.67	22.75	21.21
SEm±	-	-	-	0.01	-	-	-	-	-	0.05	0.06	0.04	0.28	0.23	0.18	0.54	1.00	0.57	0.07	0.15	0.08	1.06	1.10	0.76
CD (P≤0.05)	NS	NS	NS	0.02	NS	NS	NS	NS	NS	0.19	0.24	0.13	1.09	0.91	0.59	2.12	3.93	1.85	0.27	0.60	0.27	4.17	4.30	2.49
Varieties (V)																								
DPEPP-15-1 (Him Palam Meethi Phali-1)	10.52	11.20	10.86	2.00	2.04	2.02	6.79	8.01	7.40	4.02	4.12	4.07	10.80	15.43	13.12	43.10	64.11	53.60	10.26	15.97	13.11	36.44	41.78	39.11
DPEPP-10-1 (Him Palam Meethi Phali-2)	11.13	11.42	11.28	1.81	1.90	1.86	6.57	7.82	7.20	3.83	4.02	3.92	10.85	14.24	12.54	41.17	58.17	49.67	9.90	14.60	12.25	34.44	43.56	39.00
Mithi phali	9.00	8.87	8.94	2.03	2.12	2.07	5.87	6.51	6.19	3.26	3.19	3.22	7.75	11.49	9.62	25.27	36.73	31.00	5.84	8.58	7.21	29.00	35.56	32.28
Arka apoorva	9.35	10.21	9.78	2.02	2.03	2.02	6.68	7.49	7.08	3.67	3.69	3.68	10.61	11.76	11.19	38.48	43.60	41.04	8.83	10.41	9.62	31.22	37.44	34.33
SEm±	0.12	0.13	0.09	0.02	0.02	0.01	0.12	0.15	0.10	0.05	0.08	0.05	0.16	0.26	0.15	0.49	0.84	0.49	0.05	0.20	0.10	0.77	0.82	0.56
CD (P≤0.05)	0.36	0.40	0.26	0.05	0.07	0.04	0.37	0.45	0.28	0.15	0.25	0.14	0.49	0.78	0.44	1.47	2.50	1.40	0.16	0.59	0.30	2.28	2.43	1.61
Interaction (D × V)	NS	NS	NS	NS	NS	NS	NS	NS	NS	S	NS	NS	S	S	S	S	S	S	S	S	S	S	S	S

Where' S- Significant and NS- Non significant.

significantly longer period to achieve these phenophases. The differences in the genotypes for days to 50% flowering and first picking have also been reported by Sharma *et al.* (2014) with different varieties of garden pea and by Thakur *et al.* (2015) in edible podded pea. The days to 50% flowering in a variety determined the first picking of fresh pods of that variety *e.g.,* DPEPP-10-1 being early in flowering also had provided early first picking. Similar findings were also reported by Sharma *et al.* (2013) in garden pea. The difference among varieties to reach different phonological stages is more of a genetic character and is less dependent on management practices and hence DPEPP-10-1 took lower days while Mithi Phali took more time to flower and give first pick. Contrary to the results on days to flowering and first picking, variety DPEPP-15-1 took maximum number of days to physiological maturity followed by DPEPP-10-1 while the other varieties matured earlier.

Amongst the varieties, significant differences were recorded for pod yield attributes namely, pod length, pod width, seeds/pod and average pod weight (Table 2). On pooled basis, significantly longer pods were recorded in DPEPP-10-1 followed by DPEPP-15-1, Arka Apoorva and Mithi Phali in that order, each variety differing significantly from one another. The differences in pod length amongst the varieties may be ascribed due to their genetic constitution (Sharma *et al.* 2014). There were significant differences for pod width with significantly higher pod width recorded in Mithi Phali while DPEPP-10-1 had significantly thinner pods while the other two varieties were at par with each other.

Significantly higher number of seeds/pod were recorded in DPEPP-15-1 (Table 2) though this variety was at par with DPEPP-10-1 during both years and with Arka Apoorva during 2018-19 while Mithi Phali recorded significantly lower seeds/pod during both the years. Similarly, DPEPP-15-1 recorded significantly higher average pod weight, pods/plant and pod yield/plant followed by DPEPP-10-1, Arka Apoorva and Mithi Phali in that order each variety differing significantly from each other for all these parameters.

In both the years of study as well as in pooled basis DPEPP-15-1 produced significantly higher pod yield followed by DPEPP-10-1 and Arka Apoorva while significantly lower pod yield was recorded by Mithi Phali variety. Both the test varieties DPEPP-15-1 and DPEPP-10-1had significantly higher harvest duration while Mithi Phali had significantly lower harvest duration. This increase in pod yield was the result of higher pod weight, pods/plant, seeds/pod, pod length and harvest duration. Mukherjee *et al.* (2013) was also of the same opinion that best performance in superior genotype was the result of maximum value of yield contributing characters. Significant differences among varieties for yield and yield attributes have also been reported by Thakur *et al.* (2015) for edible podded pea while Kumar *et al.* (2015), Katoch *et al.* (2016) and Sharma *et al.* (2020) observed the same in sister crop garden pea.

Interactions (Sowing date × variety)

The interaction data between genotypes and date of sowing (Fig 1) revealed that at all the dates of sowing varieties DPEPP-10-1, remaining at par with DPEPP-15-1, took significantly lower days to 50% flowering while Mithi Phali took more days to reach 50% flowering. Also, DPEPP-10-1 sown on 21st October remaining at par with DPEPP-15-1 sown on this date took significantly lower days to reach 50% flowering while significantly higher number of days were recorded in Mithi Phali sown on 20th November though this was also at par with Arka Apoorva sown on this date as well as both these varieties sown on 5th November. The interaction effects were also significant between sowing dates and varieties for pods/plant, pod yield per plant, pod yield (t / ha) and harvest duration (Fig 2). Significantly higher values of all yield attributes namely, pods/plant, pod yield per plant and pod yield were recorded from DPEPP-15-1 sown on 21st October followed by DPEPP-10-1 sown on same date while significantly lower values of all these attributes were recorded from the sowing of Mithi Phali on 20th November. Sowing of DPEPP-15-1 and DPEPP-10-1 on 21st October had significantly longer harvest duration than

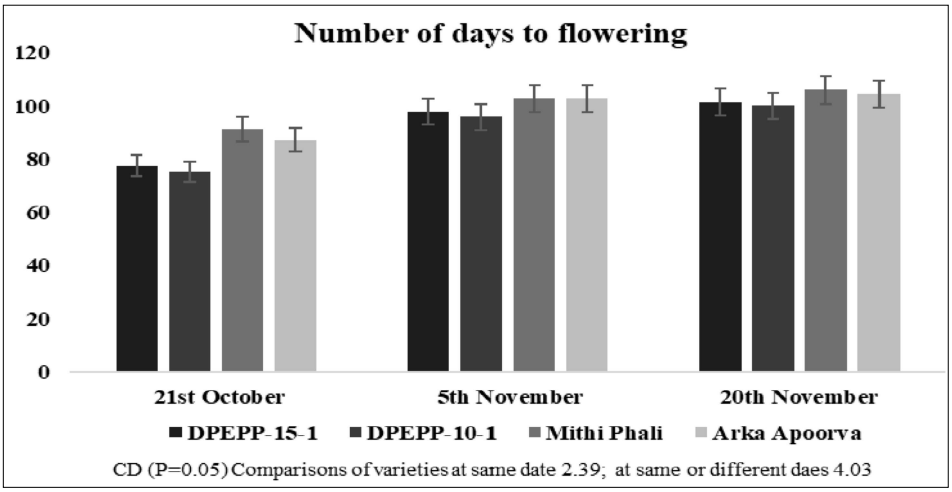

Fig 1: Interaction effects of dates of sowing and varieties on number of days to 50% flowering (pooled years).

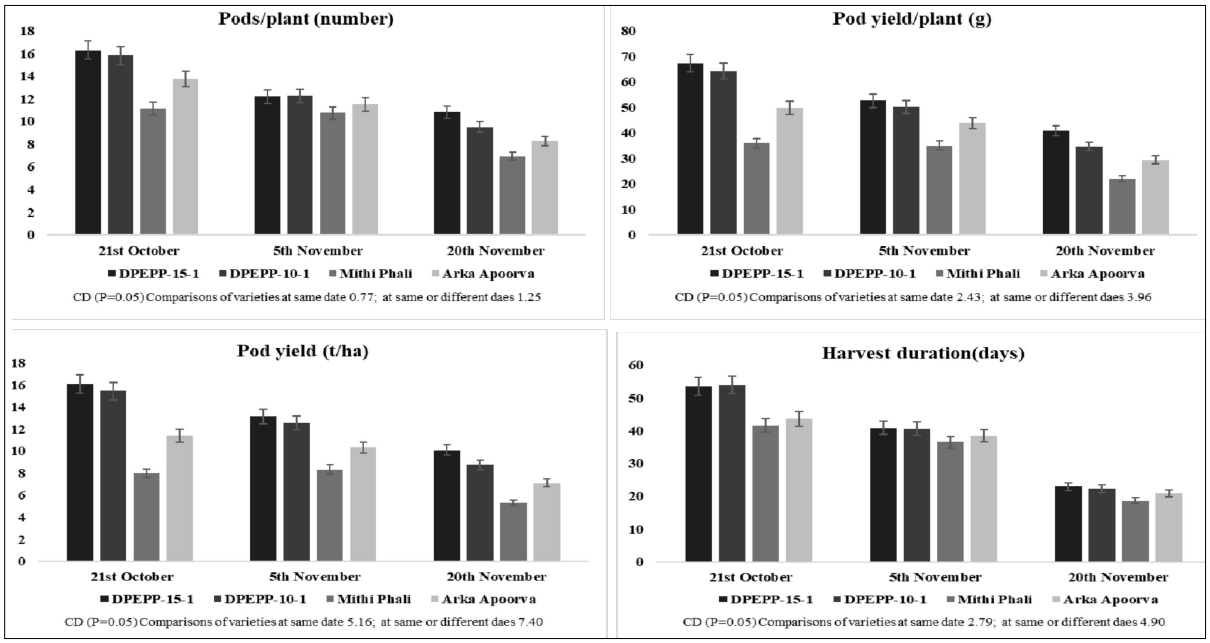

Fig 2: Interaction effects of dates of sowing and varieties on different yield traits (pooled over years).

the other two varieties and also over other sowing dates. The postponement in date of sowing from 21st October to 20th November led to the availability of lesser cool growing period which accelerated the development stages of the crop, thereby shorten the crop duration that resulted in low performance of genotypes in late sown crop. Further, the better performance of these varieties when sown in early dates may be attributed to long vegetative period owing to medium tall plants, more nodes/plant, pods/plant and harvest duration. Mukherjee *et al.* (2013) and Sharma *et al.* (2014) had also recorded better performance in early sown garden pea due to longer and favourable growing season and lower canopy temperature at vegetative state. Similar observations had been recorded by Gawad *et al.* (2013) in edible podded pea. Rise in temperature after mid-march caused early senescence of late sown crop and hence drastic reduction in yield.

CONCLUSION

Early sowing of snow pea on 21st October resulted in significantly early flowering and picking besides longest harvest duration, better pod attributes and high pod yield. DPEPP-10-1 was earliest in flowering and pod picking followed by DPEPP-15-1 in comparison to Arka Apoorva and Mithi Phali. DPEPP-15-1 performed significantly better for seeds/pod, average pod weight, pods/plant, pod yield and harvest duration followed by DPEPP-10-1. Interaction between sowing dates and varieties revealed that early sowing of DPEPP-15-1 and DPEPP-10-1 significantly out yielded the same varieties planted later as well as the other two varieties sown at all the dates. Also, DPEPP-15-1, DPEPP-10-1 and Arka Apoorva performed better when sown on 21st October while Mithi Phali gave higher yield when sown on 5th November.

Conflict of interest: None.

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