Asian Research Journal of Agriculture

13(2): 26-34, 2020; Article no.ARJA.61014
ISSN: 2456-561X

Influence of Date of Sowing on Growth and Yield Performance of Field Pea (*Pisum sativum* L.) Genotypes

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Authors' contributions

This work was carried out in collaboration among all authors. Author AKH planned the experiment and lead the research. Authors BA and AKH designed and carried out the research. Authors MEH and PSS performed the statistical analysis. Authors BA and MSH carried out the research on the field. Authors BA and FA collected the data. Authors BA and MEH wrote the manuscript. Authors MSH, FA and PSB managed the literature searches. All authors provided critical feedback and helped shape the research, analysis and manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2020/v13i230099
Editor(s):
(1) Dr. M. Yuvaraj, Adhiparasakthi Agricultural College, India.
Reviewers:
(1) Ashish P. Lambat, Rashtrasant Tukadoji Maharaj Nagpur University, India.
(2) Necat Togay, Mugla S. K. University, Turkey.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61014

Original Research Article

Received 02 July 2020
Accepted 09 September 2020
Published 21 September 2020

ABSTRACT

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during October 2014 to March 2015 to study the growth and yield performance of field pea varieties as influenced by date of sowing. The experiment comprised of two factors namely, date of sowing and variety. Date of sowing comprised of 29 October, 13 November and 28 November and the variety comprised of BARI motor-1, BADC motor-1, Natore local and Narail local. The experiment was laid out in a split plot design with three replications. The results indicate that all the growth characters were varied significantly at different days after. Those growth

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characters except leaf area index were highest for the crop sown on 28 November. The growth characters were highest in variety Natore local and lowest in Narail local except dry matter it was lowest in BADC motor-1. The interaction effect of 28 November sowing, Natore local was highest for all of the growth parameters except leaf area index it was highest on 13 November sowing and the interaction on 29 October sowing BARI motor-1 gave the lowest value. Most of the yield contributing parameters significantly affected by sowing date. The highest seed yield (827.7 kg ha-^{1}) and other yield contributing characters were found on early sowing (13 November) and the lowest seed yield (534 kg ha-^{1}) and other yield contributing characters was at 28 November sowing. Variety had significant effect on yield and yield contributing parameters. The highest seed yield (1032.2 kg ha-^{1}) and Stover yield (3221.35 kg ha-^{1}) was obtained from Natore local while Narail local gave lowest (469.1 kg ha-^{1}) seed yield and lowest Stover yield. The interaction of 13 November with Natore local gave the highest seed yield (1319.3 kg ha-^{1}) and lowest seed yield was produced by Narail local (330.35 kg ha-^{1}) by late sowing (28 November). It can be concluded that, vegetative growth were highest at 28 November sowing and yield components gave highest value on 13 November sowing. Highest yield was produced by Natore local at 13 November sowing but yield was reduced drastically when the crop sown on 28 November. So, it is clear that the optimum date of sowing for field pea is at 13 November.

Keywords: Dry matter; field pea; leaf area index; pod and yield.

1. INTRODUCTION

Pulses are the main source of protein for the people, particularly for the poor section of Bangladesh and it is called the poor men's meat as it is the cheapest source of protein. But at present pulses are beyond the reach of the poor people because of its high price due to less production. In Bangladesh per capita consumption of pulses is only 14.72 g [1] as against 45.0 g recommended by World Health Organization. To maintain the supply of this level it is needed to import pulse and as a result the Government of Bangladesh has to spend a huge amount of foreign currency every year. The total production of pulses in Bangladesh in 2016-17 was 2,40,000 metric tons from an area of 2,65,587 hectares [1]. So pulse production should be increased urgently to meet up the demand. Therefore, to meet the suggested requirement of pulses of 45 g per capita per day, the production has to be increased even more than four folds. The agroecological condition of Bangladesh is favorable for growing this crop. It is a drought tolerant crop and can be grown with a minimum supply of nutrients. Pea (*Pisum sativum* L.) is an annual plant, with a life cycle of one year. Pea (*Pisum sativum* L.) is one of the world's oldest domesticated crops cultivated before 10 and 9 millennia BC [2]. The crop is grown in many countries and currently ranks fourth among the pulses in the world with a cultivated area of 6.33 million hectares. It is a cool season crop grown in many parts of the world; planting can take place from winter to early summer depending on location. The average pea weighs between 0.10 and 0.36 g. The crop is generally cultivated for its green pods. It is highly nutritive and is rich in protein. It is used as a vegetable or in soup, canned frozen or dehydrate. Split grains of pea are widely used for dal.

The growth and yield performance of pea depend on many factors. Among them adjustment of sowing date plays an important role in increasing plant growth and seed yield. In principal, delay in sowing beyond and optimum date result in a progressive reduction in the potential yield of pea. Peas require a cool, moist climate. The pea seed germinate and grow vigorously at lower temperature than do many other pulses. High temperatures induce flowering before the plants have grown sufficiently to bear in good crops. It is considered to be an important legume crop throughout the world, and their productivity is depend on sowing date and variety interaction as well as on agronomic practices. Field pea is grown on marginal lands of poor fertility and low soil moisture status and under poor management conditions. Photoperiod and temperature are major environmental factors that change from day to day effects and reflected in the growth, flowering and seed maturity of pea. The choice of a suitable sowing date thus means suitable weather conditions for pea varieties, leading to higher yields. Any decrease in temperature to below 15^{0}C during the germination or vegetation stages retards metabolic processes and lead to seed abortion or poorer flower set compared to temperature of 15-20^{0}C [3]. Appropriate sowing date and variety effect on the growth and yield of

peas by utilizing resources. It is cool season crop, suited to production in temperate regions and at higher altitudes or in the cooler season in the warmer regions of the world. Peas require specific conditions to grow well and are sensitive to weed competition, moisture stress, disease incidence and rotation length [4]. Early maturing pea variety showed that seed yield, pods plant-^{1}, pod length, seeds pod-1 from a November sowing were all superior to an October sowing. Randhir *et. al.* (1996) [5] reported that, sowing date is a major determinant of crop yield as it determines crop duration. The trend in crop production is for early sowing to optimize yield. Yield is increased because crops have a longer growing season and photosynthesis for longer. Also early growth allows earlier canopy closure and a gives a greater competitive edge to the crop over some weed species.

At present the acreage and production of field pea in Bangladesh is very small. The production area has been drastically reduced due to introduction of HYV rice and wheat. In Bangladesh most of the pea varieties are inbred type and those are low yielder. Average yield of pea is very low (1 t ha-^{1}) [1] and the probable reason for low yield of seed legumes is mostly due to low yielding potentiality of local varieties. Use of high yielding variety could overcome the low yields to some extent. There are high yielding variety of field pea which was released by the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Institute of Nuclear Agriculture (BINA). All of these varieties are not well extensively cultivated all over the country. The farmers are still using the low yielding local varieties. So, research is essential to find out suitable high yielding varieties for establishing field pea as profitable crop in different regions of Bangladesh. Crop yield can be improved by manipulation of sowing in proper time. Suitable sowing time ensure normal plant growth because of efficient utilization of moisture, light and temperature and thus increase the crop yield. No systematic research so far has been carried out in Bangladesh to develop package of management practices including these aspects required to achieve higher yield of this crop. Mid November is considered to be the optimum time for sowing field pea in Bangladesh. But at that time in most cases, land is not ready for field pea sowing due to late harvesting of T. Aman rice. The low yield of the crop is characterized by several biotic and abiotic factors. Yield loss in pea can vary between 30% and 60% depending on varieties, sowing time, location, and climatic conditions during growing season [6]. Some pea varieties have capacity to tolerate drought and in that case sowing time can be delayed. However, earlier or late sowing causes drastic reduction in yield and net profit compared with timely sowing. Optimum time for sowing of field pea may vary with variety and agro-ecological condition. Especially in Rabi season, optimum time of sowing should be determined, which will help the farmer to get satisfactory returns by compensating for the management gap. To investigate the effect of sowing date on the growth, yield and yield components of field pea varieties, the field experiment was planned.

2. MATERIALS AND METHODS

2.1 Experimental Site and Experimental Framework

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to study the growth and yield performance of field pea varieties as influenced by date of sowing. The experimental field was medium high land with moderate drained condition. The land was silty loam in texture having a soil pH value of 6.5, low in organic matter content that is 2.11% and its general fertility level was also low. The experiment was laid out in a split-plot design with three replications. Each replication was divided into three main plots and each of the main plots was then sub divided into four unit plots. Date of sowing was assigned in the main plots and varieties in the subplot. The total numbers of unit plots were 36. The area of each unit plot was 6.0 m×2.0 m having a sub-plot to sub-plot distance 0.75 m. The distance between the main plots was 1.0 m. The treatments were randomly assigned to the plots within each replication. Three sowing date: i) 29 October sowing (D1), ii) 13 November sowing (D2), iii) 28 November sowing (D3) and four Pea variety) BARI motor-1 (V1), ii) BADC motor-1 (V2), iii) Natore local (V3), iv) Narail local (V4) were used in this experiment. The mean air temperature during the crop cycle was maximum (27.5^{0}c) in October 2014 and minimum (18.9^{0}c) in January 2015.Other recommended crop management practices were followed.

2.2 Recording of Data

Growth parameter such as leaf area index, dry matter production was determined at 45, 60 and 75 DAS. Three plants were randomly selected

from each replication to collect data on leaf area index, dry weight. For leaf area Index, leaves of three plants from each replication and their area were measured by an automatic leaf area meter (Type AAN-7, Hayashi Dam Ko Co., Japan). Leaf area index was calculated as the ratio of total leaf area and total ground area of the sample as described by Hunt (1978) [7].

$$LAI = \frac{LA}{P}$$

Where, LA=Leaf area of the sample (cm^2) P= Area of the land covered by the sample (cm^2)

To determine total dry matter, three hills were randomly taken from the outside of harvest area at 45, 60 and 75 DAS. The roots of each plant were removed, then the plants were washed with tap water and leaf and stem of the plants were partitioned, the destructive plant samples were packed in labeled brown paper bags and dried in the oven at 85±^{0}c for 72 hours until constant weight was reached. The leaf and stem samples were weighed after oven drying to measure the dry weight of plant. Grain yield and yield component data such as Plant height at harvest (cm), Number of branches plant-^{1} , Number of pods plant-1, Pod length (cm), Number of seeds pod-^{1}, Weight of 1000 seeds (g), Seed yield (kg ha-^{1}), Stover yield (kg ha-^{1}), Harvest index (%) were collected at maturity.

2.3 Statistical Analysis

The collected data were analyzed statistically using the Analysis of Variance (ANOVA) technique with the help of computer package M-STAT and mean differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984) [8].

3. RESULTS AND DISCUSSION

3.1 Effect of Sowing Date and Variety

3.1.1 Leaf Area Index (LAI)

At 75 DAS 28 November sowing gave the highest Leaf Area Index (4.31) and lowest Leaf Area Index (3.20) was obtained on 13 November sowing (Table 1). Jamil (2006) [9] reported that, plants sown in late November had a higher leaf area index (LAI) and greater yield than earlier sowing in mid-November. Varietal differences regarding LAI might be due to their differences in genetic constituents. Leaf area index was significantly influenced by variety it is revealed that Natore local gave the highest Leaf Area Index (4.58) at 75 DAS. The lowest Leaf Area Index (3.42) was obtained in Narail local at 75 DAS (Table 2).

3.1.2 Dry matter

The highest dry matter (0.36 and 1.43 g) was found at 29 October sowing at 45 and 60 DAS respectively and at 75 DAS (3.95 g) was found at 28 November sowing while the lowest (0.28, 0.76 and 2.80 g) was with 13 November sowing (Table 1). It is revealed that Natore local gave the highest Dry matter (0.39, 1.83 and 4.59 g) at 45, 60, 75 DAS and lowest dry matter (0.27, 0.92 and 2.85 g) was obtained in BADC motor-1 at 45, 60, 75 DAS but at 60 DAS lowest dry matter was statistically identical to Narail local (Table 2). The dry matter yield plant^{-1} increased with the age of plant and within the period of 60-75 DAS it increased rapidly but in early stages increased slowly and the increment in plant dry matter production was very fast during the period from 60 DAS to harvest.

3.1.3 Days to flowering

The longest duration (55 days) for days to flowering was observed on 13 November sowing and the shortest (36 days) on 28 November sowing (Table 1). Variation of flowering days is due to the variation of photoperiodic interception by plants. Days to flowering varied significantly among the varieties Narail local required the longest duration (53 days) for days to flowering. Next longest (50 days) duration was required for BADC motor-1. While the shortest (39 days) was for Natore local (Table 2).Variation in days to flowering was probably due to differences in genetic makeup of the varieties.

3.1.4 Plant height at harvest

Maximum plant height (133.30 cm) was found at 13 November sowing which was statistically identical to 29 October sowing while the minimum (116.80 cm) was with 28 November sowing (Table 1). The reduction in plant height due to delayed planting might be due to the premature flowering because of strong photoperiod sensitivity of the variety which forced the plants to switch from vegetative stage to the reproductive stage. Highest plant height was observed in BADC motor-1 (136.30 cm) and lowest plant height (122.73 cm) was found in Narail local (Table 2) which was statistically identical to BADC motor-1 and Natore local. These differences are due to the genetic variation among the varieties.

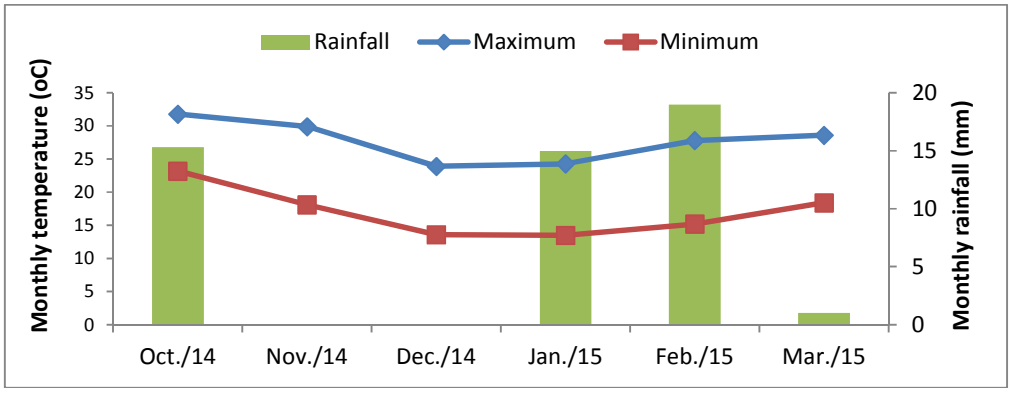

Fig. 1. Monthly total rainfall and average temperature of Mymensingh during 2014-15

3.1.5 Number of branches plant^{-1}

The highest number of branches plant^{-1} (4.26) was found in 29 October sowing and next highest (4.01 cm) was observed at 13 November sowing. While the lowest (3.86) on 28 November sowing (Table 1). It was observed that the number of branches plant decreased with delay in sowing. BARI motor-1 had the highest (4.38) number of branches plant^{-1} which was statistically identical to BADC motor-1, while Natore local had the lowest (3.62) (Table 2) which was statistically identical to Narail local. This variation was due to genetic makeup of plants.

3.1.6 Number of total pods plant^{-1}

It varied significantly among the dates of sowing .The highest number of pods plant^{-1} (21.25) was found in 29 October sowing while the lowest (11.59) was on 28 November sowing (Table 1). Varieties differed significantly for number of pods plant^{-1}.The highest number of pods plant^{-1} (19.69) was obtained from BARI motor-1 while the lowest one (14.70) was found in Narail local (Table 2). Knott (1996) [10] reported that, number of pods plant^{-1} is variable and depends on cultivar.

3.1.7 Pod length (cm)

Sown at 13 November gave the longest pod (4.77 cm) and 29 October sowing gave the shortest pod (4.50 cm) which was statistically identical to 28 November sowing (4.53) (Table 1). Variety had significant influence on pod length .The longest pod (4.93 cm) was found in Natore local while the shortest (4.37 cm) was in Narail local (Table 2). This indicates that all varieties did not have equal potentiality to produce long pods under similar condition.

3.1.8 Number of seeds pod^{-1}

Maximum number of seeds pod^{-1} (4.96) was produced by 28 November sowing and the lowest number (4.63) were observed in 29 October sowing (Table 1). Maximum number of seeds pod^{-1} (4.85) was produced by Natore local and the lowest number (4.73) were observed in BARI motor-1 (Table 2).

3.1.9 1000-seed weight (g)

The highest 1000 seed weight (75.78 g) was found at 13 November sowing which was statistically identical to 29 October sowing and the lowest (63.81 g) was for 28 November sowing (Table 1). Late sowing of pea reduced the seed weight due to interruption in seed formation mainly mediated by low temperature and short day length, resulted small sized seed and ultimately influenced grain weight negatively. 1000 seed weight was significantly affected by the varieties. The highest 1000 seed weight was found in Natore local (120.20 g) and the lowest (52.38 g) was in BARI motor-1 that was statistically identical to Narail local and BADC motor-1 (Table 2).The probable reason of the different 1000 seed weight due to the genetic make-up of the variety which is primarily influenced by heredity. Varshney (1995) [11] found that 1000 seed weight differed significantly among the varieties.

3.1.10 Seed yield (kg ha^{-1})

The highest seed yield (827.7 kg ha^{-1}) was found with 13 November sowing and the lowest was (534 kg ha^{-1}) with 28 November sowing (Table 1).Here 30% more yield was obtained in early sowing than late sowing because early sowing give the optimum interception of photoperiod by

plants and yield reduction was occurred for the exposure of plants in unfavorable climatic condition due to late sowing during reproductive period. McDonald and peck (2009) [6] reported that, the grain yield was 20 % higher in the earlier sown crop rather than the late sown crop. Varieties had a significant effect on seed yield. The highest seed yield (1032.2 kg ha^{-1}) was produced by Natore local and the next highest seed yield (699.3 kg ha^{-1}) was obtained from BADC motor-1, while the lowest (469.1 kg ha^{-1}) was in Narail local. Highest yield in Natore local was due to production of higher number of pods $plant^{-1}$ and seeds $plant^{-1}$ (Table 2). Ranalli *et. al*. (1992) [12] reported that, performance of a cultivar mainly depends on interaction of genetic makeup and environment. Further, optimum temperature and relative humidity during grain filling period might also be responsible for maximum translocation of photo assimilates towards final end product.

3.2 Interaction Effect of Sowing Date and Variety

3.2.1 Leaf Area Index (LAI)

Significant effect was found on the interaction of date of sowing and variety at all sampling dates for leaf area index (LAI). At 75 DAS highest leaf area index was observed in Natore local sown on 28 November (4.84) which was statistically identical to Natore local sown on 13 November and the lowest was in BADC motor-1 (2.47) which was identical to BARI motor-1 sown on 29 October (Table 3).

3.2.2 Dry matter

At 45, 60 DAS the highest dry matter (0.45, 2.6 g) was observed in Natore local sown on 29 October but at 75 DAS the highest (5.98 g) was in Natore local sown on 28 November and next highest at 45 DAS was for BARI motor-1 and Narail local on 29 October sowing (Table 3). The increasing dry matter over time because dry matter mainly depends on leaf dry weight and stem dry weight. Stem dry weight was increased over time and the leaf area and photosynthetic organs would be also increased over time that causes improve in dry matter production.

3.2.3 Days to flowering

Longest flowering days (60) was observed in BADC motor-1 sown on 13 November which is statically identical to Narail local on 13 November sowing. The shortest (30) flowering days was observed for Natore local on 28 November sowing (Table 3).

3.2.4 Plant height at harvest

The tallest plant was observed in BADC motor-1 sown on 29 October (139.4 cm). The shortest was in Narail local (99.50 cm) sown on 28 November which was statistically identical to 28 November sowing for BARI motor-1 (Table 3).

3.2.5 Number of branches $plant^{-1}$

The highest (5.16) number of branches $plant^{-1}$ was in variety BADC motor with 29 October sowing and lowest (2.40) was with Natore local on 29 October sowing (Table 3). The reduction is due to the negative response of variety for long photoperiod.

3.2.6 Number of total pods $plant^{-1}$

The highest number of pods $plant^{-1}$ (28.0) was produced by BARI motor-1 with 29 October sowing, while the lowest (9.0) was in Narail local for in 28 November sowing (Table 3). More number of pods per plant may be due to small pod size as less nutrient are required for small pods compared with larger pods.

3.2.7 Pod length (cm)

The longest pods (5.17 cm) were produced by Natore local on 13 November sowing. The shortest pods (4.04 cm) were produced by Narail local in 28 November sowing (Table 3).

3.2.8 Number of seeds pod^{-1}

Maximum number of seeds pod^{-1} (5.13) was found in Natore local at 28 November while the lowest (4.46) was in BARI moto-1 on 29 October sowing (Table 3).

3.2.9 1000-seed weight (g)

Natore local produced highest 1000-seed weight (126.0 g) for 13 November sowing. The lowest value (43.73 g) was in BADC motor-1 for 28 November sowing (Table 3).

3.2.10 Seed yield (kg ha^{-1})

The highest seed yield (1319.3 kg ha^{-1}) was produced by Natore local at 13 November sowing and lowest seed yield (330.35 kg ha^{-1}) was produced by Narail local on 28 November sowing (Table 3). Higher yield due to the exposure of plants in favorable environmental condition during reproductive stages because it gave highest number of pods and seeds $plant^{-1}$.

Table 1. Effect of date of sowing on yield and yield contributing characters of field pea

Date of sowing	Leaf area index			Dry matter plant^{-1} (g)			Days to flowering	Plant height (cm)	Number of branches plant^{-1}	Number of total pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})
	Days after sowing			Days after sowing										
	45	60	75	45	60	75								
29 October	0.46b	1.24b	3.59b	0.36a	1.43a	3.70b	52b	131.34a	4.26a	21.25a	4.50b	4.63c	71.79a	770.5b
13November	0.39c	1.09c	3.20c	0.28b	0.76c	2.80c	55a	133.30a	4.01ab	18.56b	4.77a	4.76b	75.78a	827.7a
28 November	0.54a	1.97a	4.31a	0.22b	1.38b	3.95a	36c	116.8b	3.86b	11.59c	4.53b	4.96a	63.81b	534.0c
Level of significance	**	**	**	**	**	**	**	**	*	**	*	**	**	**
CV%	11.97	6.99	6.32	14.09	6.57	4.26	7.26	6.15	7.62	5.34	4.75	3.20	7.07	6.66

In a column figures with similar letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT
***indicates significant at 1% level of probability*

Table 2. Effect of variety on yield and yield contributing characters of field pea

Variety	Leaf area index			Dry matter plant-1 (g)			Days to flowering	Plant height (cm)	Number of branches plant^{-1}	Number of total pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})
	Days after sowing			Days after sowing										
	45	60	75	45	60	75								
BARI motor -1	0.46b	1.42b	3.54b	0.30b	1.04b	3.13c	48b	125.00b	4.38a	19.69a	4.48bc	4.73	52.38b	642.7c
BADC motor-1	0.43b	1.40b	3.50b	0.27c	0.92c	2.85d	50ab	136.30a	4.32a	17.07b	4.62b	4.80	54.12b	699.45b
Natore local	0.56a	1.81a	4.58a	0.39a	1.83a	4.59a	39c	123.51b	3.62b	17.09b	4.93a	4.85	120.20a	1032.2a
Narail local	0.40c	1.28c	3.42c	0.28b	0.96c	3.38b	53a	122.73b	3.87b	14.70c	4.37c	4.76	53.38b	469.1d
Level of significance	**	**	**	**	**	**	**	**	**	**	**	NS	**	**
CV%	11.97	6.99	6.32	14.09	6.57	4.26	7.26	6.15	7.62	5.34	4.75	3.20	7.07	6.66

In a column figures with similar letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT
***indicates significant at 1% level of probability*

Table 3. Effect of interaction of date of sowing and variety of yield and yield contributing characters of field pea

Sowing date × variety	Leaf area index			Dry matter plant-1 (g)			Days to flowering	Plant height (cm)	Number of branches plant^{-1}	Number of total pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})
	Days after sowing			Days after sowing										
	45	60	75	45	60	75								
D_1×V_1	0.48bc	1.06d	2.72f	0.48bc	1.06d	2.72f	53bc	138.71a	4.87a	27.86a	4.21de	4.46d	58.11cd	764.2c
D_1×V_2	0.36de	0.84e	2.47f	0.36de	0.84e	2.47f	53bc	139.40a	5.16a	26.70ab	4.47cd	4.60cd	64.75c	887.5b
D_1×V_3	0.53b	1.95b	3.22e	0.53b	1.95b	3.22e	41d	108.4b	2.40e	11.23f	4.90ab	4.83bc	122.00a	916.3b
D_1×V_4	0.48bc	1.14d	3.24e	0.48bc	1.14d	3.24e	59a	138.9a	4.63a	19.20c	4.44cd	4.64cd	53.17de	514.0de
D_2×V_1	0.48bc	1.20d	4.18b	0.48bc	1.20d	4.18b	54b	135.20a	4.73a	19.70c	4.64bc	4.90abc	51.71def	685.7c
D_2×V_2	0.28e	0.88e	3.51d	0.28e	0.88e	3.51d	60a	137.21a	3.90bc	13.40e	4.63bc	4.74cd	53.88de	743.2c
D_2×V_3	0.49bc	1.16d	4.21a	0.49bc	1.16d	4.21a	45c	128.20a	3.40cd	25.60b	5.17a	4.60cd	126.90a	1319.3a
D_2×V_4	0.34de	1.15d	2.92ef	0.34de	1.15d	2.9ef	60a	129.73a	4.03b	15.57d	4.64bc	4.83bc	54.63de	563.1d
D_3×V_1	0.44bcd	2.00b	3.73d	0.4bcd	2.00b	3.73d	37f	101.23b	3.53bc	11.50f	4.61bcd	4.83abc	47.31ef	478.2de
D_3×V_2	0.66a	1.99b	4.10b	0.66a	1.99b	4.10b	37f	132.32a	3.90bc	11.10f	4.770bc	5.07ab	43.73f	467.1e
D_3×V_3	0.68a	2.34a	4.84a	0.68a	2.34a	4.84a	30g	134.0a	5.06a	14.43de	4.700bc	5.13a	111.80b	860.3b
D_3×V_4	0.39 cd	1.57c	3.90c	0.39 cd	1.57c	3.90c	39e	99.50b	2.970d	9.33g	4.04e	4.83bc	52.35def	330.35f
Level of significance	**	**	**	**	**	**	**	**	**	**	*	**	*	**
CV%	11.97	6.99	6.32	11.97	6.99	6.32	7.26	6.15	7.62	5.34	4.75	3.20	7.07	6.66

*In a column figures with similar letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS showed non significant effect * and **indicates significant at 5% and 1% level of probability, respectively*

D_1 = 29 October D_2 = 13 November D_3 = 28 November V_1 = BARI motor -1 V_2 = BADC moror-1 V_3 = Natore local V_4 = Narail local

These results are similar with the findings of Hanaa and Ali (2000) [13] where they reported that seed yield of field pea varied among the interaction of variety and sowing date due to variation in number of pods and seeds plant^{-1}.

4. CONCLUSION

It could be concluded that sowing date, variety and their interaction had significant effect on growth, yield and yield attributes of field pea. Late sowing (28 November) of field pea reduced the seed yield by 30% obtained from the early sowing (13 November). Natore local gave the highest seed yield at 13 November sowing but reduction of yield was occurred at 28 November sowing and the lowest seed yield was produced by Narail local sown on 28 November. The above result revealed that growth and yield of field pea varied due to varieties, date of sowing as well as with their interaction. Among four varieties Natore local gave the highest yield at 13 November sowing. Therefore it is suggested to sow Natore local field pea variety at Mid-November.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. BBS (Bangladesh Bureau of Statistics). Statistical Year Book of Bangladesh Bureau of statistics. Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka. 2018;47-50.
2. Zohary D, Hopf M. Domestication of Plants in the Old World. 3rd edition. Oxford University Press. 2000;316.
3. Gubbles GH. Quality, yield and weight per seed of green field peas as affected by sowing and harvest date. Canadian J Plant Science. 1977;579:1029–1032.
4. Corre-Hellou G, Crozat Y. N2 fixation and N supply in organic pea *(Pisums sativum* L.) cropping systems as affected by weeds and pea weevil *(Sitonal ineatus L.)*. European J Agron. 2005;22:449-458.
5. Randhir S, Mohan S, Kanwar JS. Effect of date of sowing on growth and seed yield of early maturing pea variety Matar Ageta-6. Punjab Vegetable Grower. 1996;31:35-36.
6. McDonald GK, Peck, D. Effects of crop rotation, residue retention and sowing time on the incidence and survival of ascochyta blight and its effect on grain yield of field peas (*Pisum sativum* L.). Field Crops Res. 2009;111:11-21.
7. Hunt R. Plant Growth Analysis. Study in Biology No.96. Edward Arnold, London. 1978;27-30.
8. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research (2nd Edn.). John Willey and Sons, Singapore. 1984l;28-92.
9. Jamil MK. Growth analysis and yield of garden pea as influenced by variet and sowing date. I J Sustainable Agricultural Technology. 2006;2:32-41.
10. Knott CM. Optimum sowing dates and plant populations for winter peas (*Pisum sativum*). J Agricultural Science, Cambridge. 1996;131:449-454.
11. Varshney JG. Response of dwarf pea cultivars to date of sowing and row spacing. Indian Journal of Pulses Research. 1995;8(1):33:35.
12. Ranalli PI, Giordano U, Ziliotto GM. Yield potential of pea for dry seed in different Italian environments. Sementi-Elette. 1992; 38:15-43.
13. Hanaa HM, Ali EA. Agronomic performance of seven pea (*Pisum sativum*) genotypes with five sowing dates in sandy soil. Acta Agronomica Hungarica. 2000;59: 337–347.

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