



Influence of different sowing dates and cultivars on growth, yield and disease incidence in garden pea (*Pisum sativum*) under mid hill situation

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ABSTRACT

A field experiment was conducted during the winter season of 2010-11 and 2011-12 at the Regional Research Station (Hill Zone) of Uttar Banga Krishi Viswavidyalaya, Kalimpong, to elucidate the effect of different sowing date and cultivars on yield of garden pea (*Pisum sativum* L.). The experiment was laid out in split plot design with treatment comprising three dates of sowing, viz. 26 October, 18 November and 04 December in main plots and 8 different pea cultivar, viz. Phanthom, PSM (3), Early 6, GS 10, Azad P 1, Arkel, Pusa Pragati and Darjeeling local in subplots and replicated three times. Sowing at 26 October, significantly influenced the number of pods/plant and was statistically similar with 18 November sowing, and significantly better to other set of sowing. Analysis revealed that 39.2 and 30.6 % more pods/plant with 26 October and 18 November, sowing respectively compared to the late sowing, i.e. 04 December. The number of pods/plant was highest with cultivar, viz. GS 10 (26.66) and was closely followed by Darjeeling local (25.31) and Early 6 (25.02). These were at par to each other and significantly superior to rest of the tested cultivars. Maximum pod production was obtained with 26 October, sowing which was significantly superior to all other date of sowing. This was followed by November 18, however, least pod yield was registered with extreme late sown condition, i.e. 04 December. Amongst the cultivar, GS 10 was found to be best because of maximum value of yield attributing characters and gave significantly more pod yield (78.64 q/ha), and was at par with Early 6 (76.25 q/ha) and Darjeeling local (75.98 q/ha), whereas Arkel gave significantly lower yield than all other cultivars under trial. GS 10 recorded 31.71 % pod yield over the genotype Arkel, which produced lowest grain yield amongst all tested cultivars. Amongst the cultivars, Arkel experience the maximum disease incidence and this was statistically at par with disease reaction with Azad P1 followed by Phanthom. The cultivar GS 10 has experienced less disease incidence compared to all other tested cultivars during all the sowing dates. The relationship between powdery mildew incidence and weather factors indicated a negative correlation between maximum and minimum temperature with a correlation coefficient of -0.37 and -0.53, respectively. Net return of ₹ 29 553 was higher reported with 18 November, sowing and was followed by late 26 October (₹ 34 621). However, higher benefit: cost ratio of 2.47 was recorded with 26 October, sowing. Amongst all varietal treatments, maximum net return (₹ 32 925/ha) and benefit: cost ratio (2.40) was recorded with cultivar GS 10 and was followed by Early 6 and Darjeeling local.

Key words: Correlation, Cultivars, Disease incidence, Pea, Sowing date

Pea (*Pisum sativum* L.) is a popular vegetable and pulse crop of India and particularly in north eastern Himalayan range. It provides varieties of vegetarian dishes and hence, it is liked throughout the world. Vegetable pea or garden pea is cultivated under diverse agroclimatic situations (500 m to 2200 m asl) in eastern Himalaya during the *rabi* season in the low to high hill regions and during summer in the dry, temperate areas. Peas are important grain legumes. Dry pea cropping has major advantages in sustainable farming systems

because of its low requirement for water, chemicals and fossil energy; ability to symbiotically fix atmospheric nitrogen which precludes the need for N-fertilizer; and reduced emissions of N₂O, NO₃ and CH₄, which, in addition to CO₂ savings, significantly reduce the greenhouse effect of agricultural activities (Munier and Carrouee 2003). Yield potential of pea in north eastern Himalaya is not being exploited fully due to many factors, among which use of improper sowing date and low yielding varieties are the most important ones. The north eastern hills contribute about 2.3% of the total production of garden pea in the country. The productivity of pea in the region is around 7 tonnes/ha, as compared to the national average of 11.5 tonnes/ha. Around 90 % of the pea in the region is cultivated under rainfed

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condition, while irrigated area is only 4%. Besides, comparatively cooler season and short crop duration in this zone provides congenial condition to achieve fairly good yield (Mukherjee 2010). Despite this pea productivity in this region is quite low as compared with the national average (Singla *et al.* 2006). Most of the vegetable pea, which is sown in this region, is late sown due to late harvesting of rice and other crops. Date of planting plays an important role in productivity of pea. Drastic reduction in yield of pod has been recorded with the delay of sowing beyond optimum time. It has been estimated that delay in sowing of pea beyond last week of November, resulted in yield reduction of 1-2 tonnes/ha. Late sown garden pea exposed to both the extreme of temperature, i.e. low temperature during early growth period, and also affected by powdery mildew incidence due to erratic rainfall in winter season. Further the vegetable pea crop which is mainly grown in the hilly region is not properly standardized (Mukherjee 2012). Due to lack of improved varieties and unavailability of technical guidance regarding optimum date of sowing farmer either receives low returns or they kept their land fallow. Therefore, an experiment was planned to find out optimum date of sowing for different varieties of garden pea along with the meteorological influence on disease incidence for vegetable pea for the condition prevailing in eastern Himalaya. The study on powdery mildew development in relation to environmental factors would help us to quantify the correlation and the variability existing among the different independent variables on the dependent variable.

MATERIALS AND METHODS

The experiment was conducted during the winter season of 2010-11 and 2011-12 at Regional Research Station (Hill Zone) under the aegis of Uttar Banga Krishi Viswavidyalay, Kalimpong with an altitude of 1250 m asl. The soil was sandy loam in texture, high in organic carbon (0.73%), available N (221.5 kg/ha), P (9.9 kg/ha) and K₂O (79 kg/ha) content with pH 5.2. The total rainfall recorded during crop growth period was 19.2 and 16.3 mm, minimum temperature ranges from 1.3 to 12.6 °C and 2.7 to 14.3, and maximum temperature 19.2 to 29.3 and 17.8 to 32.6 °C during winter 2010-11 and 2011-12, respectively. The experiment was laid out in split plot design with treatment comprising three dates of sowing, viz. 26 October, 18 November and 04 December in main plots and 8 different pea cultivar, viz. Phanthom, PSM (3), Early 6, GS 10, Azad P 1, Arkel, Pusa Pragati and Darjeeling local in subplots and replicated three times. Pea varieties were sown with row spacing of 50 cm and plant spacing of 7.5 cm. The crop received full dose of N: P: K (30:60:40 kg/ha) during the early phase of life cycle. The source of fertilizer was urea, single super phosphate and muriate of potash for N, P and K, respectively. Pre-emergence application of pendimethalin 0.75 kg a.i./ha was given 2 days after sowing followed by one hand weeding at 40 DAS (days

after sowing) for complete check of weed during critical period of crop-weed competition. Other management practices were adopted as per recommendations of the crop under rainfed situation. For working out the economics, prevailing market prices for pea seed (₹40.50/kg), urea (₹ 9.75/kg), SSP (₹ 13.90/kg), MOP (₹ 8.15/kg) and cost of labour (₹ 112.50 /day) were considered. Data related to growth phase was recorded at maximum growth phase (60 DAS) and rest of the yield attributing character was measured at the time of harvesting. Ten leaves from each treatment and replication were tagged to observe the disease incidence with the help of score card (0 to 10 scale) given by Falloon *et al.* (1995) Conversions of disease scores from disease severity assessment data to percentage surface area has been done using two different conversions formula, i.e. $Y = 5 X$ (for disease scores < 4); and $Y = 13.3 X - 33$ (for disease scores > 4); where Y = % of surface area diseased, and X = mean disease score. Conversions to percentage surface area less than and more than 20% have different conversions. These conversions should be carried out using mean values after statistical analysis of disease scores. The pooled data of powdery mildew incidence was correlated with maximum and minimum temperature, maximum and minimum relative humidity and rainfall. Further simple and step wise multiple regressions were carried out with above parameters in relation to percent disease incidence.

RESULTS AND DISCUSSION

Growth characters

Significant differences were observed due to differences in sowing date and cultivars on growth characters of garden pea (Table 1). Date of sowing significantly influenced the growth characters, viz. plant height, fresh weight and dry matter accumulation of plant at maximum growth stage (60 DAS). Plant height was significantly more with early sowing, i.e. 26 October, and was at par with 18 November, sowing. This was followed by first week of December sowing. This corroborates the findings of Mandal *et al.* (2004). Amongst the cultivar maximum of this character was registered with Darjeeling local and was significantly superior to rest of the tested variety. This was followed by PSM (3) and GS 10. Both were at par to each other. Differences in plant height among varieties might be attributed to their genetic diversity. These results are similar to those of Sharma (2002). Fresh weight of plant varied significantly and highest of this parameter was registered with 26 October, and was significantly better than other tested date of sowing. Further, 04 December, sowing gave least fresh weight accumulation of plant. Data recorded with the cultivar revealed that maximum of this was registered with Darjeeling local and was comparable with Arkel. Least fresh weight was registered with Phanthom cultivar. Observation related to dry matter production was more with early sowing and showed parity

with 18 November sowing. Further results revealed that early sowing register 14.74 % more dry matter accumulation of crop compare to 04 December, extreme late sowing condition. Decrease in plant height and dry matter accumulation in late sowing was due to shorter growing period. Early sown crop may have enjoyed the better environmental conditions especially the temperature and solar radiation which resulted in tall plants. These results are in line with those reported by Mulusew *et al.* (2008). With the cultivar maximum dry matter was registered with Darjeeling local and was significantly higher compared to all other tested treatment except Arkel, GS10 and PSM (3). Number of branches/plant at 60 DAS was more with early sowing and was significantly more compared to rest of the date of sowing. The cultivars had shown significant difference for number of branches/plant, and was higher recorded with GS 10 and was statistically superior to rest of the tested cultivar under the mid hill condition. This was followed by Darjeeling local. However, least number of branches was recorded with Azad P1 and was followed by Arkel.

Days to 50 % flowering was higher with early sowing compared to the late sowing situation under mid hill condition of Darjeeling Himalaya. Maximum number of flower emergence was observed with 26 October, sowing and significantly more compare to other sowing date. However, nodule/plant was more registered 18 November, sowing and was statistically at par with 26 October, sowing and significantly superior to rest all other treatments. This treatment also gave higher effective nodules/plant to rest of the sowing date. Further, data in Table 1 revealed that total number of nodules/plant and effective number of nodules/

plant was more with GS 10 and was at par with cultivar Early 6. This was followed by Darjeeling local cultivar. However amongst all the cultivar least number of nodules/plant and effective nodules/plant was recorded with Azad P 1 and was closely followed by Arkel.

Yield attributes

All yield attributing characters were significantly affected by the date of sowing (Table 2). Delayed sowing decreased the number of pods/plant, grains/pod and weight of grains/pod. The pod/plant, considered as the most important yield determinant varied significantly under different dates of sowing. Sowing at 26 October, significantly influenced the number of pods/plant and was statistically similar with 18 November, sowing, and significantly better to other set of sowing. Analysis revealed that 39.2 and 30.6 % more pods/plant with 26 October, and 18 November, sowing respectively compared to the late sowing, i.e. 04 December. Further, data revealed that grains/pod and pod length was maximum with 26 October, sowing and was significantly superior to other tested sowing dates. Pod weight was higher with early sowing and was statistically similar with 18 November, sowing. Weight of grains/pod was higher and significantly more registered with 26 October, and was closely followed by 18 November, seed sowing. Shelling (%) was more with 18 November, and was at par with early sowing date (i.e. 26 October). However, least shelling percentage was registered with 04 December, sowing. Late sowing of vegetable pea significantly produced poor yield attributing characters throughout the observation. This might be due to suboptimal temperature in late sown condition reduce cell division and

Table 1 Effect of different treatments on growth pattern at maximum growth phase of garden pea (pooled data of two years)

Treatment	Plant height (cm)	Fresh weight of plant	Dry weight/ plant (g)	Branches/ plant (no.)	Dry to 50 % flowering	Total nodules/plant	Effective nodules/plant
<i>Date of sowing</i>							
October 26	122.42	182.49	71.69	2.49	47.89	64.52	49.63
November 18	115.6	175.64	66.31	2.13	45.06	58.97	45.13
December 04	94.8	167.5	56.99	1.84	43.49	51.03	35.95
SEm±	5.97	1.85	2.35	0.04	0.69	1.72	0.97
CD (P=0.05)	17.02	3.95	7.10	0.19	2.36	5.06	2.81
<i>Cultivars</i>							
Phantom	117.63	127.48	35.46	1.94	43.02	51.02	40.11
PSM (3)	172.61	169.92	38.92	2.13	44.81	62.13	44.02
Early 6	76.73	163.9	29.11	2.29	45.89	63.68	47.01
GS 10	160.41	193.2	39.81	2.47	46.61	68.4	49.71
Azad P 1	94.32	196.98	25.92	1.79	41.36	42.33	37.35
Arkel	120.65	206.9	42.10	1.87	42.97	49.82	32.91
Pusa pragati	72.30	189.67	33.65	1.96	44.90	62.01	40.51
Darjeeling local	210.53	215.69	42.32	2.01	45.65	63.99	44.5
SEm±	6.74	6.72	2.06	0.03	0.63	1.79	0.87
CD (P=0.05)	17.31	18.05	6.23	0.13	2.03	5.11	2.84

cell expansion (Singh *et al.* 2001). Reduced cell expansion also carries a primary effect on meristematic development of yield components, such as the pods/plant, grains/pod or pods weight in the garden pea leading to potential yield (Mandal *et al.* 2004).

Various cultivars show significant variation for different yield attributing characters. The number of pods/plant was highest with cultivar, viz. GS 10 (26.66) and was closely followed by Darjeeling local (25.31) and Early 6 (25.02). These were at par to each other and significantly superior to rest of the tested cultivars. Amongst all cultivars, Azad P 1 gave significantly lowest pods/plant and was statistically similar with PSM (3). Grains/pod was significantly more with Early 6 and was comparable with GS 10 and Darjeeling local cultivar. Least grains/pod was registered with Azad P 1 and was followed by Panthom and Arkel. Differences in number of grains/pod among varieties might be attributed to their genetic diversity (Akhtar *et al.* 2002). Pod length was more registered with Darjeeling local and was followed by Early 6, Pusa Pragati and PSM (3). These treatments were at par to each other and statistically superior to all other tested cultivar under mid hill situation. Pod weight was registered to be higher with GS 10 and was at par to Early 6 and significantly showed better response compared to rest of the cultivar. Weight of grains/pod, was more with GS 10 and showed distinct parity with Early 6, and significantly superior to other cultivars. Lowest of this yield attributing character was recorded with Azad P 1. Further, Table 2 depict that shelling percentage was more with GS 10, Darjeeling local and Early 6, and significantly showed better performance than other tested cultivar. However least shelling percentage was

registered with Arkel and was closely followed by Azad P1.

Yield and economics

Pod yield is a function of various yield attributing factors and maximum pod production was obtained with 26 October, sowing which was significantly superior to all other date of sowing. This was followed by 18 November, however, least pod yield was registered with extreme late sown condition, i.e. 04 December. This accrued mainly because of more dry matter accumulation and yield attributing characters (Mukherjee, 2012). Sowing in late October gave 27.61 % more grain yield over the 04 December sowing. This corroborate the finding of Akhtar *et al.* (2002). Cultivar performance in garden pea varies with time of sowing, which is contingent on the time of seasonal break in rainfed agriculture. Amongst the cultivar, GS 10 was found to be best because of maximum value of yield attributing characters and gave significantly more pod yield (78.64 q/ha), and was at par with Early 6 (76.25 q/ha) and Darjeeling local (75.98 q/ha), whereas Arkel gave significantly lower yield than all other cultivars under trial. GS 10 recorded 31.73 % more pod yield over the genotype Arkel, which produced lowest pod yield amongst all the tested cultivars.

Economic returns

Net return of ₹ 29553 was higher reported with November 18, sowing and was followed by late 26 October (₹ 34 621). However, higher benefit: cost ratio of 2.47 and 2.25, respectively recorded with the above this treatment (Table 2). Amongst all varietal treatments, maximum net return (₹ 32 925/ha) and benefit: cost ratio (2.40) was recorded

Table 2 Effect of different treatments on yield attributes, green pod yield and economics of garden pea (pooled data of two years)

Treatment	Pods/ plant	Grains/ pod	Pod length (cm)	Pod weight (g)	Weight of grains/pod (g)	Shelling (%)	Green pod yield (q/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
<i>Date of sowing</i>										
October 26	27.49	7.59	8.62	7.01	3.49	47.74	81.25	58 089	34 621	2.47
November 18	25.69	6.34	6.81	6.89	2.89	48.93	72.36	53 021	29 553	2.25
December 04	19.68	5.72	6.73	5.72	2.33	42.98	64.80	50 057	26 589	2.13
SEm±	1.02	0.24	0.29	0.19	0.12	0.72	2.08			
CD (P=0.05)	3.01	0.69	0.72	0.55	0.31	2.19	6.23			
<i>Cultivars</i>										
Phanthom	23.44	5.93	6.91	5.92	2.92	47.33	72.52	52 113	28 645	2.22
PSM (3)	21.43	6.93	7.46	6.14	3.29	44.10	71.11	51 429	27 961	2.19
Early 6	25.02	7.46	7.63	6.80	3.59	47.24	76.25	53 722	30 254	2.28
GS 10	26.66	7.25	7.15	7.01	3.85	49.65	78.64	56 393	32 925	2.40
Azad P 1	20.78	5.87	6.24	5.31	2.34	40.12	66.82	43 122	19 654	1.83
Arkel	21.53	6.51	6.51	5.09	2.56	41.08	60.25	48 055	24 587	2.04
Pusa pragati	23.94	6.87	7.28	6.39	3.01	42.56	73.45	51 652	28 184	2.20
Darjeeling local	25.31	7.09	7.82	6.23	3.07	48.16	75.98	52 493	29 025	2.23
SEm±	0.64	0.19	0.20	0.22	0.91	0.79	2.12			
CD (P=0.05)	1.96	0.62	0.63	0.65	0.26	2.36	7.09			

Table 3 Percent powdery mildew incidence of garden pea at poding on different sowing date (pooled data of two years)

Factors	Phanthom	PSM (3)	Early 6	GS 10	Azad P 1	Arkel	Pusa Pragati	Darjeeling local	Mean
26 October	68.33 (55.83)*	28.33 (32.01)	30.00 (33.14)	15.00 (22.58)	88.33 (70.66)	89.96 (74.36)	68.33 (55.83)	65.00 (53.70)	59.96 (52.31)
18 November	90.00 (71.92)	66.66 (54.81)	60.00 (50.76)	20.00 (26.44)	88.33 (70.66)	90.03 (71.92)	71.66 (58.04)	70.00 (56.81)	70.20 (58.75)
04 December	94.97 (78.91)	71.66 (57.96)	85.00 (67.37)	23.33 (28.65)	91.63 (75.62)	91.63 (75.62)	78.33 (62.45)	71.66 (58.04)	72.07 (59.42)
Mean	84.43 (68.88)	55.55 (48.25)	58.33 (50.43)	19.44 (25.89)	89.43 (72.31)	90.53 (73.97)	72.77 (58.76)	68.88 (56.20)	

CD at 5% for date of sowing 6.0994, CD at 5% for different pea cultivars 6.7401

CD for date of sowing × cultivar 12.4158, CD for cultivar × date of sowing 12.2878

*Figure in parenthesis represents the average angular transformed value of PDI

with cultivar GS 10 and was followed by Early 6 and Darjeeling local.

Disease incidence

The pooled analysis of the two years data in relation to incidence of powdery mildew disease, significant variation exist within different sowing dated (Table 3). The progressive increase in disease incidence was observed with delay in sowing and maximum disease incidence percentage value (94.97) was observed on 04 December, sown crops. This corroborate with the findings of Chatterjee *et al.* (1991). Mandal *et al.* (2004) also reported from the same location that late sown garden pea crop were badly affected by powdery mildew disease and as a result plant died. Amongst the cultivars, Arkel experience the maximum disease incidence and this was statistically at par with disease reaction with Azad P1 followed by Phanthom. Moderate level of disease incidence were recorded in case of Darjeeling local and Pusa Pragati and in early sown crops (26 October), however, disease increase steadily in these cultivar in the late sown crops (18 November). Low level of disease incidence were noticed in early sown crops of PSM (3) and Early 6 cultivars of garden pea but in late sown crops (after 18 November) disease certainly becomes severe. The cultivar GS 10 has experienced less disease incidence compared to all other tested cultivars during all the sowing dates. Interaction also produces significant response over the disease incidence on garden pea. It may be assumed that the cultivars PSM (3) and Early 6 when planted early, escaped disease, otherwise it was susceptible in late sowing. Weather parameter, viz. temperature, relative humidity and rainfall play a major role in powdery mildew disease development. As the temperature increased after winter, it creates favourable condition for powdery mildew development and which is confirmed by the increasing trends of disease incidence percentage towards delayed sowing of the crops in all the cultivars. Thus, from the present investigation it may be concluded that GS 10, PSM (3), Early 6, Darjeeling local, Pusa Pragati and Phanthom

may be sown during the month of October in the mid hills of Darjeeling District for good plant stand, better growth and higher production with tolerable level of powdery mildew disease. This disease incidence observation was in accordance with the finding of Sharma and Sharma (2002), who also found that in Nauni, maximum seed yield/ha in pea cv. Arkel can be achieved in the crop sown on 30 October, at 20 cm spacing with a cost benefit ratio of 1:0.79.

Correlation and regression analysis

Correlation coefficients between powdery mildew incidence and weather parameters are presented in Table 4. The relationship between powdery mildew incidence and weather factors indicated a negative correlation between maximum and minimum temperature with a correlation coefficient of 0.37 and 0.53, respectively. Similar results were reported by Raghavendra (2005) who explained negative correlation coefficient was observed with maximum and minimum temperature in case of chilli powdery mildew.

However, powdery mildew incidence was positively correlated with morning relative humidity, evening relative humidity and rainfall with a correlation coefficient of 0.56, 0.59 and 0.62, respectively. Significant correlation coefficient was observed with minimum temperature, maximum relative humidity, minimum relative humidity and rainfall. The results are in agreement with Saharan and Saharan (1994). However,

Table 4 Correlation coefficient (r) between powdery mildew incidence and meteorological parameters

Meteorological parameters	Correlation coefficient (r)
Maximum temperature (°C)	-0.37
Minimum temperature (°C)	-0.53*
Maximum relative humidity (%)	0.56*
Minimum relative humidity (%)	0.59*
Rainfall (mm)	0.62*

* Significant at 5% probability levels

Table 5 Simple regression equation of powdery mildew incidence with meteorological parameters

Meteorological parameters	Regression equation ($Y = a \pm bx$)	Coefficient of determination (R^2)
Maximum temperature (°C)	$Y = 97.57 - 2.15 X_1$	0.49
Minimum temperature (°C)	$Y = 102.74 - 4.24 X_2$	0.51
Maximum relative humidity (%)	$Y = 37.51 + 1.56 X_3$	0.55
Minimum relative humidity (%)	$Y = 40.47 + 2.13 X_4$	0.56
Rainfall (mm)	$Y = 64.21 + 4.05 X_5$	0.59

maximum temperature was non-significantly correlated with powdery mildew incidence.

The simple regression equation of powdery mildew incidence with the meteorological parameters has been presented in the Table 5. From the result, it is clear that weather parameters were responsible for variation in the powdery mildew incidence as evident from the R^2 value. The maximum and minimum temperature, maximum relative humidity, minimum relative humidity and rainfall were responsible for 49, 51, 55, 56 and 59% variation in the powdery mildew incidence, respectively.

The multiple regression analysis of the powdery mildew incidence data with the abiotic factors has been worked out and the results have been presented in the Table 6. Perusal of the results reveals that the maximum temperature (X_1) in association with the minimum temperature (X_2) influenced the powdery mildew incidence by 62%. Similarly these two parameters along with maximum relative humidity (X_3) influenced the powdery mildew incidence by 65%. The maximum and minimum temperature, maximum and minimum relative humidity influenced the disease development by 69%. Together all the abiotic factors was responsible for 73% variation in the powdery mildew incidence. From the values of R^2 it can be concluded that the severity of disease incidence was highly associated with weather parameters.

Table 6 Stepwise multiple regression equation of powdery mildew incidence with meteorological parameters

Regression equation	Coefficient of determination (R^2)
$Y = 106.65 + 0.89 X_1 - 5.48 X_2$	0.62
$Y = 105.46 + 2.48 X_1 - 6.61 X_2 + 1.47 X_3$	0.65
$Y = 167.32 + 2.90 X_1 - 6.90 X_2 + 2.32 X_3 + 1.94 X_4$	0.69
$Y = 239.15 + 6.47 X_1 - 11.23 X_2 - 1.52 X_3 + 1.68 X_4 + 6.51 X_5$	0.73

X_1 , maximum temperature; X_2 , Minimum temperature, X_3 , maximum relative humidity; X_4 , Minimum relative humidity; X_5 , rainfall

The multiple linear regression of powdery mildew incidence in relation to weather parameters indicated that the regression coefficients for maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall were found to be 6.47, -11.23, -1.52, 1.68 and 6.51, respectively.

It may concluded that 26 October, sowing produced maximum yield attributing character and yield, and less incidence of disease compared to rest of the sowing dates. Further, various cultivars showed significant variation for different growth and yield attributing characters. The number of pods/plant and other yield attributes was highest registered with cultivar, viz. GS 10. This cultivar recorded highest yield, less disease susceptible and more economic return (B: C ratio), compared to other tested cultivars.

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