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Influence of sowing date on downy mildew severity and yield in pea

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Abstract
Field experiments were conducted to study the influence of sowing date on the severity of downy mildew and yield of field pea. It was found that disease severity increased gradually in crops sown between 31st October and 21st November and decreased between 28th November and 5th December. The result depicts that maximum disease severity, AUDPC, infection rate and lowest grain yield (24.87%, 430.54, 0.279 and 208.42 kg/ha respectively) in crops sown on 28th November which was significantly different with early and late sown crops. Significantly, lower disease severity, AUDPC, infection rate and highest grain yield (8.10%, 84.07, 0.242 and 833.67 kg/ha respectively) was found in crops sown on 31st October.

Keywords: downy mildew, date of sowing, AUDPC, yield

Introduction
Peas are highly nutritive and contain digestible protein (7.2 g/ 100 g), Carbohydrate (15.8 g), Vitamin-C (9 mg), phosphorus (139 mg) and minerals. Pea seeds generally contain 23 per cent protein, 48 per cent starch, 8 per cent sugar, 4 per cent lipid, 7 per cent crude fiber and 3 per cent ash (Duke and Ayensu, 1985) [4]. Pea is affected by a number of fungal (rust, powdery mildew, downy mildew, root rot, alternaria blight, aschochyta blight, wilt, anthracnose, cercospora leaf spot, damping off, seedling rot etc.), bacterial (bacterial blight and brown spot), nematode (cyst nematode, lesion nematode and root-knot nematode) and viral diseases (cucumber mosaic virus, pea early browning virus, pea enation mosaic, pea mosaic, pea seed borne mosaic, pea streak and pea stunt). These diseases, under the right conditions, can significantly decrease both yield and quality. Downy mildew disease is the most common foliar disease of the pea crop (*Pisum sativum* L.) caused by *Peronospora pisi* Syd. with up to 55 % losses in yield observed where plant resistance is ineffective (Clark and Spencer-Phillips 2000) [3]. It occurs commonly in the vegetative stage of the crop leading to significant problem across the globe where peas are grown (Amey and Spencer- Phillips 2006) [1]. One of the adverse effects of downy mildew is that it cause variable ripening which creates serious problems for the processing industries (Dixon, 1981) [5]. Epidemics of the disease were reported in the USSR (Golubev and Yankov, 1979). Production of conidia by *Peronospora viciae* results in a substantial loss of photosynthate from the host to the pathogen, contributing to symptoms such as stunted growth, distortion and early death of the infected plant (Mence and Pegg 1971) [6].
Efforts have been made to breed downy mildew resistant cultivars and several are now available (Matthews and Dow, 1971). Host resistance combined with fungicidal seed treatment offers the best integrated package to control this disease (Nene *et al*., 1988) [9]. Alteration of planting dates is another important cultural practices which is followed to minimize the losses caused due to the disease. This breaks the interaction of susceptible stage of the crop with active stage of the pathogen, thus resulting in disease escape.
In present experiment effort has been made to study the affect of alteration in date of sowing and which has been found useful in planning the agronomic practices to manage the disease.

Materials and Methods
Present investigation was carried out in the field during *Rabi* season 2013-14 and 2014-15 at at N.E. Borlogue Crop Research Centre (NEBCRC), G.B. Pant University of Agriculture and Technology, Pantnagar.

Topographically, Pantnagar falls in the humid and subtropical (Tarai) climate of North West Plain Zone (NWPZ). The zone lies at the foothills of Shivalic range in lower Himalayas. It is situated at 29^0N latitude and 79.73^0E longitude, at an altitude of 243.8 m. above the mean sea level (MSL). The average relative humidity is highest (70-80%) in July-August and December–January, while lowest (35-40%) in April-May. Average rainfall in this area is about 1400 mm per annum (GBPUAT meteorological station, Pantnagar). The details of methodology and materials used during the present investigation are presented under the following headings.

Natural occurrence of downy mildew of pea at NEBCRC had been inconsistent. Since environmental conditions especially temperature and humidity play a vital role in occurrence, prevalence and severity of the disease, it was considered to correlate the two years weather data with the disease severity recorded during two successive years, *i.e. Rabi* 2013-14 and 2014-2015. The weather data was collected from the meteorological observatory located near the experimental plot.

Influence of date of sowing on the incidence and severity of downy mildew of pea.

In this experiment, cultivar *viz*. Arkel was sown at weekly intervals starting from 30th October to 12th December. Seeds were sown in a plot of 2 x 1.2 m with a spacing of 30 x 10 cm laid out in RBD with four replications at NEBCRC, Pantnagar during *Rabi* durin 2013-14 and 2014-15.

The normal recommended package of practices for high yields was followed in the field except for management practices against downy mildew disease. Incidence of downy mildew was monitored at weekly intervals starting from 4th week after sowing (WAS) till the 8th WAS. At every stage of observation, level of incidence in the previous count was also looked in carefully and finally the mean of observations was calculated. The data at each stage was subjected to RBD analysis and the population variation among dates of sowing was assessed. The yield obtained in each treatment was observed and compared among the different treatment to know the best date of sowing for pea.

The following parameters were calculated in the epidemiological studies.

AUDPC (A) value: YMD incidence was quantified using the following formulae (Nagarajan and Muralidharan, 1995)[8].

$$A = \sum_{i=1}^{k} \tfrac{1}{2} (S_i + S_{i-1}) d$$

Where S_i = Disease incidence at the end of the week i, k = Number of successive evaluations of disease, and d = Interval between two evaluations.

Apparent rate of infection ('r')

The apparent rate of infection was calculated using standard formula by Vanderplank (1968) [12].

$$r = \frac{2.303}{t_2 - t_1} \quad \frac{\log x_2 (1-x_1)}{x_1 (1-x_2)}$$

where, r is the apparent infection rate in non-logarithmic phase, x_1 is the disease index at initial week time (t_1), x_2 is the disease index at subsequent week time (t_2)

Result and Discussion

Influence of sowing date on downy mildew disease

Significant effect of sowing dates in both the years of experimentation on downy mildew and grain yield was noticed (Table 1). It is evident that disease severity increased gradually in crops sown between 31st October and 21st November and decreased between 28th November and 5th December. Maximum disease severity (26.20%) was recorded in crop sown on 28/11/13 followed by crop sown on 21/11/13 (23.27% severity). The lowest disease severity (7.65%) was recorded in earliest sown crop 31/10/13 followed by crop sown on 12/12/13 i.e. 10.64%. The AUDPC and apparent rate of infection was found maximum on 28/11/13 DOS (473.70 and 0.281 respectively) and lowest was found in earliest sown crop (92.20 and 0.181 respectively). The maximum yield (813.2 kg/ha) was recorded in early sown crop (31/10/13) followed by 12/12/13 DOS (779.0 kg/ha). The lowest yield was obtained in 28/11/13 DOS (205.0 kg/ha).

Similarly during 2014, maximum disease severity (23.27%) was recorded in crop sown on 28/11/14 followed by crop sown on 21/11/14 i.e. 18. 26% severity. The lowest disease severity (7.30%) was recorded in late sown crop (12/12/14) followed by earliest sown (31/10/14) crop i.e. 8.56%. The AUDPC and apparent rate of infection was found maximum in 28/11/14 DOS (387.37 and 0.277 respectively) and lowest was found in late sown crop (70.04 and 0.235 respectively). The maximum yield (888.33 kg/ha) was recorded on 12/12/13 sown crop followed by crop sown on 31/10/13 i.e. 806.33 Kg/ha. The lowest yield was obtained from crop sown on 28/11/13 (205.0 kg/ha) (Table 1).

The pooled data (2013-14 & 2014-15) presented in table1 depicts maximum disease severity, AUDPC, infection rate and lowest grain yield (24.87%, 430.54, 0.279 and 208.42 Kg/ha respectively) in crops sown on 28 november which was significantly different with early and late sown crops. Significantly, lower disease severity, AUDPC, infection rate and highest grain yield (8.10%, 84.07, 0.242 and 833.67 Kg/ha respectively) was found in crops sown on 31 october (Table 1).

Plant mortality caused by downy mildew was higher in the early-seeded treatment at Mannville in 2009 than in the mid or in 2010, the incidence and severity of downy mildew declined as seeding date was delayed at both Gibbons and Mannville. However, seed yield in 2010 was lower for the final seeding date than for the earlier dates (Chang *et al.*, 2013) [2]. Delay in sowing after 5 Oct., increased the incidence of *Uromyces viciae-fabae* and decreased grain yield. Cultivar Khaparkheda gave the highest seed yield (1.54 t/ha) and had the lowest incidence (Sangar and Singh, 1994) [10].

The effect of different sowing dates October 15 to December 13 on rust of field pea in relation to weather parameters during crop seasons was studied and it was observed that the crop showed least rust severity when pea was planted on October 15 during all the three crop seasons (Singh *et al.*, 2012) [11].

In other experiment the effect of sowing dates on rust disease occurrence and crop yield in lentil was studied and utobserved that incidence of disease declined from the first to last sowing date (Mittal 1997) [7].

The results of present investigation clearly show that, early and late sown crop in field face lower disease pressure and the subsequently sowing at the time occurrence of pathogen will succumb to high disease pressure. Main aim of managing the date of sowing is to disturb the interaction of host, pathogen and environment.

Table 1: Effect of date of sowing on disease severity and yield during *Rabi* 2014-15 (Pooled)

S. No.	Date of sowing	Final disease severity			AUDPC			'r' Value			Yield (Kg/ha)		
		2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
1	31/10/13	7.65 (16.061)	8.56 (17.01)	8.10 (16.54)	98.11	70.04	84.07	0.181	0.241	0.239	779.00	888.33	833.67
2	07/11/13	12.96 (21.099)	11.31 (19.65)	12.12 (20.37)	185.50	168.04	176.77	0.237	0.251	0.166	526.17	519.33	522.75
3	14/11/13	18.26 (25.295)	13.96 (21.94)	16.05 (23.62)	290.54	231.04	260.79	0.268	0.258	0.263	314.33	314.33	314.33
4	21/11/13	23.27 (28.843)	18.26 (25.30)	20.71 (27.07)	378.04	316.20	347.12	0.277	0.268	0.272	252.83	246.00	249.42
5	28/11/13	26.50 (30.983)	23.27 (28.84)	24.87 (29.91)	473.70	387.37	430.54	0.281	0.277	0.279	205.00	211.83	208.42
6	05/12/13	18.26 (25.295)	10.64 (19.04)	14.24 (22.17)	208.87	154.04	181.45	0.268	0.249	0.258	533.00	539.83	536.42
7	12/12/13	10.64 (19.038)	7.30 (15.67)	8.90 (17.36)	92.20	112.04	102.12	0.249	0.235	0.242	813.17	806.33	809.75
	CD (5%)	3.70	2.10	2.90							26.40	27.60	27.00
	CV	8.64	5.55	7.09							2.97	3.08	3.02

Value Value in parenthesis are angular transformed, 'A'- Area under disease progress curve (AUDPC), 'r' – Apparent rate of infection,

References

1. Amey RC, Spencer-Phillips PTN. Towards developing diagnostics for downy mildew diseases. Outlooks on Pest Management. 2006; 17:4-8.
2. Chang KF, Hwang SF, Ahmed HU, Strelkov SE, Conner RL, Gossen BD *et al*. Yield loss and management of downy mildew on field pea in Alberta, Canada. Crop Protection. 2013; 46:23-28.
3. Clark JSC, Spencer-Phillips PTN. Downy Mildews. In: The Encyclopaedia of microbiology. J. Lederberg, M. Alexander BR, Bloom D, Hopwood R, Hull BH, Inglearski AI, Laskia SG, Oliver M, Schaechter, & W. C. Summers, eds Academic Press, San Diego, USA, 2000, 117-129.
4. Duke JA, Ayensu ES. Medicinal Plants of China. Reference Publications. Inc.: ISBN 0-917256-20-4. Reference Publications, Algonac, MI (USA), 1985.
5. Dixon GR. Downy mildews on peas and beans. In: The downy mildews. D.M. Spencer (eds). Academic Press, New York, USA, 1981, 636.
6. Mence MJ, Pegg GF. The biology of *Peronospora viciae* on pea: factors affecting the susceptibility of plants to local infection and systemic colonisation. Annals of Applied Biology. 1971; 67:297-308.
7. Mittal RK. Effect of sowing dates and disease development in lentil as saole and mirxed crop with wheat. J Mycol. Pl. Pathol. 1997; 27(2):203-209
8. Nagarajan S, Muralidharan K. Dynamics of Plant Diseases, Allied Publ. Ltd., New Delhi, 1995, 247.
9. Nene YL. Multiple disease resistance in grain legumes. Annual review phytopathology. 1988; 26:203-16.
10. Sangar RB, Singh VK. Effect of sowing dates and pea varieties on the severity of rust, powdery mildew and yield. Indian J Pul. Res. 1994; 7(1):88-89.
11. Singh P, Panotra N, Singh P, Singh KN, Raihana Habib K. Spikelet sterility, harvest index and yield of rice (Oryza sativa.) cultivars as influenced by low temperature and transplanting dates in temperate Kashmir. Indian J Agron. 2012; 57(4):83-87.
12. Vanderplank JE. Disease resistance in plants. Academic Press, New Press. 1968, 210.