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Original Research Article

Estimation of Losses and Management (Quantitative and Qualitative) Caused by Downy and Powdery Mildewin Field Pea

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A B S T R A C T

The maximum mortality (4.00%) was found in treatment T_7 (control) followed by T_5 (Apron+Triatimefon @ of 0.2%) and T_2 (*Pseudomonas fluorescence*+Karathane) which are significantly at par to each other. Apron+Karathane (T_1), Apron+Calyxin (T_4) and *T.viride*+Nativo (T_6) were found less effective. Maximum disease rating score 5 in 1 to 9 scale was recorded in T_2, T_3 and T_7 while it was minimum score one in T_1, T_4 and T_5. In treatment T_6 the disease score was rated as 3. On the basis of above the disease severity index was calculated which was found maximum in T_7 (check) having PDI of 48.88%. The minimum PDI was recorded 11.11% in T_1, T_4 and T_5. The number of pod/plant maximum 14.50 pods / plant was noted in cultivar T_2 and T_7 respectively while minimum 11.5 pods were observed in cultivar T_6 cultivar T_2 being on par with cultivar T_7 and T_4 produced significantly more number of pods/plant as compare two rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 15.29 pods / plant were noted in protected plant which was significantly superior to unprotected plant which produced minimum 11.14 pods/plant. The number of seed/pod maximum 6.00 seed / pod was noted in cultivar T_7. While minimum 4.00 seeds were observed in cultivar T_1. Cultivar T_3 and T_5 being at par with cultivar T_2 and T_6 produced significantly more number of seeds / pod as compare two rest cultivars. Environment given to the crop also in influenced the production of seeds and maximum 6.29 seeds / pod were noted in protected plant which was significantly superior to unprotected plant which produced minimum 4.00 seed/plant. The 1000 seeds test weight maximum 132.50(gm) were noted in cultivar T_6. Cultivar T_3 being on par with cultivar T_2 and T_5 produced significantly more 1000 seeds test weight as compare two rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 143.29g (1000 seeds test weight) were noted in protected plant which was significantly superior to unprotected plant which produced minimum 113.57g (1000 seeds test weight).

Keywords

Pea, Powdery Mildew, Downy Mildew, mortality, qualitative

Introduction

Pea (*Pisum sativum* L.) is the third most widely grown grain legume worldwide, commonly called as matar, in Hindi, belongs to family leguminaceae and cultivated as an important vegetable as well as pulse crop throughout the world. Field pea originated in Europe and Western Asia and is grown throughout the world as a cool season crop. (Paul *et al.*,2003)reported that during recent surveys, 15-20 % incidence of pea downy mildew caused by *Peronospora pisi (P.viciae f. sp. pisi)* was recorded from the Indora area of Kanga Himanchal Pradesh, India. (Bhardwaj and Shrama 1984; Chauhan *et al.*, 1991)reported that due to its continuous cultivation, powdery mildew has assumed serious proportion. These diseases (Powdery mildew and rust) usually appear late in the season, reaching maximum intensity during pod formation stage. (Sheridan, 1996)found 20 per cent lower yield in downy mildew infected crop in comparison to health/ crop. Downy mildew develops on pea seedlings when conditions are cool and moist. Cold, dewy nights promotes the disease occurs almost sporadically in all pea growing regions depending upon environmental conditions and the presence of inoculums and susceptible host. The pathogen survives as oospores in soil for upto 10 years (Gaag and Frinking1996). The symptom develops in the form of grayish white, moldy growth appears on lower leaf surface and a yellowish area appears on the opposite side of leaf. Infected leaves can turn yellow and die if weather is cool and damp. Stems can be distorted and stunted. Brown blotches appear on pods and mould may grow inside pods.

Powdery mildew caused by the pathogen *Erysiphepisi* is a serious disease of pea. The pathogen is obligate parasite act as bio-troph. (Linnaeus,1753)was the first to name a powdery mildew as an organism by using the binomial *Mucorerysiphe* to a white fungus on the leaves. Powdery mildew first appears on the upper surface of the lower most (oldest) leaves as small (4-5mm diameter), scattered, white, almost circular colonies which eventually coalesce as the colonies grow further covering the entire leaf surface under favourable environmental conditions. Colony colour changes from white to greyish brown, plants become stunted. Mildew appears as fine talcum powder like appearance. Leaf, stem, floral parts and pods get affected.

Improper seed setting, reduced number and size of seeds. The conidia of *E. pisi.* can germinate on living/ non- living substrates at wide range RH and limited of temperature. The involvement of phenolic compounds in induced resistance against powdery mildew pathogen was demonstrated by (Maranon, 1924).

Materials and Methods

For downy mildew the percent plant mortality was recorded while for powdery mildew the no. of pod, seed setting or no. seed/pods, 1000 seed wt, germination %, root- shoot length was calculated. The field experiment was conducted during *Rabi* 2016-2017 at the G.P.B. Farm, Acharya Narendra Dev University of Agriculture and technology Kumarganj, Ayodhya (U.P.).

A randomized block design consisting of forty nine germplasms (forty nine varieties of Pea) replicated three times with a plot size of 5m × 1.50m was executed.

Evaluation of chemicals and bio-agents against downy and powdery mildew under field condition

T_1 Seed treatment with Apron 6g/kg of seed + 2 Foliar Spray of Karathane @ 1.00 lit/ha. (I at disease appear and IInd after 15 days)

T_2 Seed treatment with *P. fluorescens*4g/kg of seed+ 2 Foliar Spray of Karathane@ 1.00 lit/ha (I at disease appear and IInd after 15 days)

T_3 Seed treatment *T. viride*@ 4g/kg of seed + 2 Foliar Spray of Karathane @ 1.00 lit/ha. (I at disease appear and IInd after 15 days)

T_4 Seed treatments with Apron 6 g/kg+ 1 foliar spray of calyxin @ 2 g/ha. when disease appears

T_5 Seed treatment Apron 6 g/kg+ 2 Foliar Spray of Triadimefon (Bayleton 25 WP @ 0.2%) (I at disease appear and IInd after 15 days)

T_6 Seed treatment *T. viride*@ 4g/kg of seed+ 2 Foliar Spray Nativo 0.4g/lit (I at disease appear and IInd after 15 days)

T_7 No seed treatment and no foliar spray

Results and Discussion

Estimation of losses

Downy mildew

The data presented (Table 1) maximum mortality (4.00%) was found in treatment T_7 (control) followed by T_5 (Apron+Triatimefon @ of 0.2%) and T_2 (*Pseudomonas fluorescence*+Karathane) which are significantly at par to each other. Apron+Karathane (T_1), Apron+Calyxin (T_4) and *T.viride*+Nativo (T_6) were found less effective. Maximum disease rating score 5 in 1 to 9 scale was recorded in T_2, T_3 and T_7 while it was minimum score one in T_1, T_4 and T_5. In treatment T_6 the disease score was rated as 3. On the basis of above the disease severity index was calculated which was found maximum in T_7 (check) having PDI of 48.88%. The minimum PDI was recorded 11.11% in T_1, T_4 and T_5. All the three treatments were significantly at par to each other. The similar results found by (Sangarand Paliwal, 1997) applied Kimberlite @ 5.0 tonnes/ha and found lower disease incidence of downy mildew and increase grain yield. (Sharma *et al.*, 2003) observed in cucumber crop that Ridomil MZ (1000ppm) caused maximum reduction in sporangial formation followed by acrobat MZ (1000 ppm). In protective spray programme, maximum disease control as well as fruit yield and minimum infection rate (r) and AUDPC were observed by sprays of Ridomil MZ (0.25%) and Acrobat mz-0.25%, Ridomil MZ-0.25% also exhibited maximum anti sporulant activity up to 7 days.

Powdery mildew

Number of pod per plant

Seven cultivars of pea were tested under different environments to assess the impact of Downey mildew thus the data assembled on account of number of pod per plant have been presented in (Table 2).An examination of data indicates that different cultivars have their pronounced impact on number of pod/plant maximum 14.50 pods / plant were noted in cultivar T_2 and T_7 respectively while minimum 11.5 pods were observed in cultivar T_6 cultivar T_2 being on par with cultivar T_7 and T_4 produced significantly more number of pods/plant as compare two rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 15.29 pods / plant were noted in protected plant which was significantly superior to unprotected plant which produced minimum 11.14 pods/plant. As for interaction effect on variety and environment is concerned. It was noted that interaction of above factor was non significant. However maximum 17 pod/plant was noted under protected condition in cultivar T_2 and

minimum 9 pods/plant were observed in cultivar T_6 under unprotected conditions. Data assembled on account of number of seed/pod have been presented in (Table 3). An examination of data given indicates that different cultivars have their pronounced impact on number of seed/pod maximum 6.00 seed / pod was noted in cultivar T_7. While minimum 4.00 seeds were observed in cultivar T_1. Cultivar T_3 and T_5 being at par with cultivar T_2 and T_6 produced significantly more number of seeds / pod as compare two rest cultivars. Environment given to the crop also in influenced the production of seeds and maximum 6.29 seeds / pod were noted in protected plant which was significantly superior to unprotected plant which produced minimum 4.00 seed/plant. As for interaction effect on variety and environment is concerned. It was noted that interaction of above factor was non significant. However maximum 7 seed/pods was noted under protected condition in cultivar T_3, T_5 and T_7, and minimum 3 seed /pod were observed in cultivar T_1 under unprotected conditions. An examination of data given in (Table 4) clearly indicates that different cultivars have their pronounced impact on number of seed setting percentage per pod maximum 83.50 seed setting percentage per pod were noted in cultivar T_5 and T_7 respectively. While minimum 78.00 seed setting were observed in cultivar T_3 cultivar T_4 and V_6 seed setting percentage per pod being on par with cultivar T_3 produced significantly more number of number of seed setting percentage per pod as compare one rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 91.85 percent seed setting per pod were noted in protected plant which was significantly superior to unprotected plant which produced minimum 69.57 seed setting percentage per pod. Interaction effect on variety and environment was not significant. However maximum 95% seed setting per pod was noted under protected condition in cultivar T_7 and minimum 66% seed setting per pod were observed in cultivar T_6 under unprotected conditions. An examination of data given in (Table 5) clearly indicates that different cultivars have their pronounced impact on 1000 seeds test weight maximum 132.50(gm) were noted in cultivar T_6. While minimum 123 was observed in cultivar T_4. Cultivar T_3 being on par with cultivar T_2 and T_5 produced significantly more 1000 seeds test weight as compare two rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 143.29g (1000 seeds test weight) were noted in protected plant which was significantly superior to unprotected plant which produced minimum 113.57g (1000 seeds test weight). Combined effect of variety and environment did not show any significant impact. However maximum 148.00g test weight was noted under protected condition in cultivar T_6 and minimum 108.00g test weight was observed in cultivar T_4 under unprotected conditions. Data assembled on account of number of pod per plant have been presented in (Table 6) indicates that different cultivars have their pronounced impact on Seed germination % maximum 81.5 were noted in cultivar T_5. While minimum 78.00 % germinations were observed in cultivar T_3. treatments T_2 being on par with cultivar T_4 and T_6 produced significantly more seed germination % as compare two rest cultivars. Environment given to the crop also in influenced the production of pods and maximum 82.71 % germination were noted in protected plant which was significantly superior to unprotected plant which produced minimum 76.57 Seed germination %. As for interaction effect on variety and environment is concerned that interaction of above factor was non significant. However maximum 84% germination was noted under protected condition in cultivar T_2 and T_5 minimum 75% germination were observed in cultivar T_3 and

T_7 under unprotected conditions. An examination of data given in (Table 7) clearly indicates that different cultivars have their pronounced impact on Seedling length maximum 22.15 was noted in cultivar T_5. While minimum Seedling lengths 20.70 were observed in cultivar T_4. cultivar T_6 being on par with cultivar T_2 and T_7 produced significantly more Seedling length as compare two rest cultivars. Environment given to the crop also in influenced the Seedling length and maximum 22.57 Seedling length were noted in protected plant which was significantly superior to unprotected plant which produced minimum 20.36 Seedling length. As for interaction effect on variety and environment is concerned that interaction of above factor was non significant. However maximum 23.30 Seedling length was noted under protected condition in cultivar T_6 and minimum 19.50 were observed in cultivar T_4 under unprotected conditions.

Vigour index

Data assembled on account of number of pod per plant have been presented in (Table 8) clearly indicates that different cultivars have their pronounced impact on Vigour indexes maximum 1807.60 were noted in cultivar T_5. While minimum vigour 1632.30 was observed in cultivar T_3. cultivar T_6 being on par with cultivar T_2 and T_1 produced significantly more vigour index as compare two rest cultivars. Environment given to the crop also in influenced the show vigour index maximum 1867.21 were noted in protected plant which was significantly superior to unprotected plant which show minimum vigour index 1559.11. As for interaction effect on variety and environment is concerned that interaction of above factor was non significant. However maximum vigour index 1940.40 was noted under protected condition in cultivar T_5 and minimum vigour index 1474.50 were observed in cultivar T_3 under unprotected conditions. Powdery mildew is the serious handicap in successful pea cultivation almost throughout the country as in cause's high crop losses (Howare1971; Mathur *et al.*, 1971). The losses in yield in 100 percent infected crop were estimated to be 21-31 percent in pod number and 26-47 percent in pod weight (Manjul *et al.*, 1963). However, an average reduction of over 50 percent in grain yield is an annual feature (Singh and Singh1982). In addition to loss in yield, some indirect adverse effect of plant growth due to powdery mildew by (Shahid *et al.*, 2010)worked out the effect of powdery mildew disease on no. of pods, no. of grain/pod and 1000 grain weight.

Effect of seed treatments (chemicals, and bio-agents)

The PDI of all the treatments in (Table 9) differed invariably the maximum (44.70%) being in untreated/unsprayed (check) plot while it was recorded minimum (5.40%) in T_2 followed by T_3 (5.90%) and T_1 (6.20%). Accordingly T_1, T_2 and T_3 were significant at par to each other with respect of PDI. The maximum disease control (87.91%) in T_2 followed by T_3 (86.80%) and T_1 (86.12%) over untreated unsprayed plot (T_7) was worked out. However, all the 3 treatments viz-T_1, T_2 and T_3 were significantly at par to each other with respect to percent disease control. The maximum production of (11.50 q/ha) in T_1 followed by T_2 (11.00 q/ha) and T_3 (10.50 q/ha) over untreated/unsprayed plot T_7 was worked out. However all the three treatments *viz.*,T_1, T_2 and T_3 were significantly at par to each other with respect to yield q/ha. The percent increase in yield over control differed in variably the maximum (91.66%) in T_1 followed by T_2 (83.33%) over untreated/unsprayed plot T_7 was worked out.

Table.1 Effect of variable seed treatments (fungicidal/bio-agents) and fungicidal foliar sprays against field emergence establishment and severity of downy mildew

Treatment	Emergence (%) DAS-20	Natural mortality (%)	Appearance disease	Incidence	PDI
T_1	76.00 (60.67)	2.0.0 (8.13)	25/12/2016	1	11.11 (19.46)
T_2	81.00 (64.16)	3.00 (9.98)	21/12/2016	5	42.22 (40.51)
T_3	78.00 (62.03)	2.00 (8.13)	23/12/2016	5	40.00 (39.23)
T_4	79.00 (62.72)	2.00 (8.13)	26/12/2016	1	11.11 (19.46)
T_5	76.00 (60.67)	3.00 (9.98)	25/12/2016	1	11.11 (19.46)
T_6	79.00 (62.72)	2.00 (8.13)	23/12/2016	3	34.44 (35.51)
T_7	73.00 (58.69)	4.00 (11.54)	17/12/2016	5	48.88 (44.34)
SEm±	2.67	0.19	0.22	-	0.76
CD(P=0.05)	8.24	0.58	-	0.68	2.34

(The figures given in parenthesis are angular transformed values)

Table.2 Number of pods per plant

Treatments	Environments		Average
	Protected	Unprotected	
T_1	15.00	11.00	13.00
T_2	17.00	12.00	14.50
T_3	14.00	11.00	12.50
T_4	16.00	12.00	14.00
T_5	15.00	10.00	12.50
T_6	14.00	9.00	11.50
T_7	16.00	13.00	14.50
Av	15.29	11.14	13.21
	Treatment (T)	Environment (E)	TxE
SEm±	0.37	0.20	0.53
CD(P=0.05)	1.08	0.58	NS

Table.3 Number of seed per pods

Treatments	Environment		Average
	Protected	Unprotected	
T_1	5.00	3.00	4.00
T_2	6.00	4.00	5.00
T_3	7.00	4.00	5.50
T_4	6.00	4.00	5.00
T_5	7.00	4.00	5.50
T_6	6.00	4.00	5.00
T_7	7.00	5.00	6.00
Av	6.29	4.00	5.14
	Treatment (T)	Environment(E)	TxE
SEm±	0.16	0.08	0.22
CD (P=0.05)	0.45	0.24	NS

Table.4 Number of seed setting percentage per pod

Treatments	Environment		Average
	Protected	Unprotected	
T_1	90	70	80
T_2	92	66	79
T_3	91	65	78
T_4	90	71	80.5
T_5	92	75	83.5
T_6	93	68	80.5
T_7	95	72	83.5
Av	91.85714	69.57143	80.71429
	Treatment (T)	Environment(E)	TxE
SEm±	2.40	1.28	3.40
CD (P=0.05)	6.98	3.73	NS

Table.5 1000 seeds test weight

Treatments	Environment		Average
	Protected	Unprotected	
T_1	140.00	110.00	125.00
T_2	144.00	115.00	129.50
T_3	146.00	117.00	131.50
T_4	138.00	108.00	123.00
T_5	145.00	114.00	129.50
T_6	148.00	117.00	132.50
T_7	142.00	114.00	128.00
Av	143.29	113.57	128.43
	Treatment (T)	Environment(E)	TxE
SEm±	4.00	2.14	5.65
CD(P=0.05)	11.63	6.22	NS

Table.6 Seed germination percentage

Treatments	Environment		Average
	Protected	Unprotected	
T_1	82.00	76.00	79.00
T_2	84.00	77.00	80.50
T_3	81.00	75.00	78.00
T_4	83.00	77.00	80.00
T_5	84.00	79.00	81.50
T_6	83.00	77.00	80.00
T_7	82.00	75.00	78.50
Av	82.71	76.57	79.64
	Treatment (T)	Environment(E)	TxE
SEm±	2.29	1.22	3.23
CD(P=0.05)	6.65	3.55	NS

Table.7 Seedling length

Treatments	Environment		Average
	Protected	Unprotected	
T_1	22.30	20.23	21.27
T_2	22.60	20.55	21.58
T_3	22.10	19.66	20. 88
T_4	21.90	19.50	20.70
T_5	23.10	21.20	22.15
T_6	23.30	20.95	22.13
T_7	22.70	20.40	21.55
Av	22.57	20.36	21.46
	Treatment (T)	Environment(E)	TxE
SEm±	0.66	0.35	0.93
CD(P=0.05)	1.92	1.03	NS

Table.8 Vigour index cultivars under field condition

Treatments	Environment		Average
	Protected	Unprotected	
T_1	1828.60	1537.48	1683.04
T_2	1898.40	1582.35	1740.38
T_3	1790.10	1474.50	1632.30
T_4	1817.70	1501.50	1659.60
T_5	1940.40	1674.80	1807.60
T_6	1933.90	1613.15	1773.53
T_7	1861.40	1530.00	1695.70
Av	1867.21	1559.11	1713.16
	Treatment (T)	Environment(E)	TxE
SEm±	48.30	25.81	68.30
CD (P=0.05)	140.42	75.06	NS

Table.9 Effect of seed treatments (Fungicidal and Bio-agent) and fungicidal foliar sprays against powdery mildew in field pea

Treatments	PDI	Per-cent disease control	Yield qt./ha	Per-cent increase in yield over control
T_1	6.20	86.12 (68.11)	11.50	91.66 (73.20)
T_2	5.40	87.91 (69.64)	11.00	83.33 (65.88)
T_3	5.90	86.80 (68.70)	10.50	75.00 (60.00)
T_4	17.70	60.40 (51.00)	09.00	50.00 (45.00)
T_5	20.20	54.80 (47.75)	08.50	41.66 (40.19)
T_6	27.00	44.09 (41.81)	08.00	33.33 (35.24)
T_7	44.70	-	06.00	00.00
SEm±	0.62	2.52	0.34	2.48
CD(P=0.05)	1.90	7.77	1.05	7.63

(The figure given in parenthesis is angular transformed values)

However all the two treatments T_1 and T_2 were significantly at par to each other with respect to percent increase in yield over control. The similar results found by (Gandhi *et al.*,1997; Rajappan andYesuraja2000) studied on biological control agent *Tricoderma viride* compared with chemical treatment for the control of *Erysiphepolygoni* on pea in Tamil Nadu, India in 1997-1998. Powdery mildew incidence with talc-based *T. viride* formulation treatment was 77.00 and 52.80%in 1997 and 1998, respectively, compared with 78.50 and 62.90% in the control. The pea yield from the *T. viride* treatment was 1.68 and 1.58 kg/plot, compared with 1.59 and 1.50kg/plot in the control in 1997 and 1998, respectively. A foliar spray of wettable sulphur reduced disease incidence to 47.0and 38.50% and result in pea yields of 2.30 kg/plot. The efficacy of wettable sulphur was not significantly different from that of Tridemorph and Dinocap.

Effect on variety and environment is concerned it was noted that interaction of above factor was non significant. However maximum 17 pod/plant was noted under protected condition in cultivar T_2 and minimum 9 pods /plant were observed in cultivar T_6 under unprotected conditions. Interaction effect on variety and environment is concerned it was noted that interaction of above factor was non significant. However maximum 7 seed/pod was noted under protected condition in cultivar T_3, T_5 and T_7, and minimum 3 seed /pod were observed in cultivar T_1 under unprotected conditions. Interaction effect on variety and environment was not significant. However maximum 95% seed setting per pod was noted under protected condition in cultivar T_7 and minimum 66% seed setting per pod were observed in cultivar T_6 under unprotected conditions. Combined effect of variety and environment did not show any significant impact. However maximum 148.00g test weight was noted under protected condition in cultivar T_6 and minimum 108.00g test weight was observed in cultivar T_4 under unprotected conditions. The variety and environment is concerned it was noted that interaction of above factor was non significant. However maximum 84% germination was noted under protected condition in cultivar T_2 and T_5 minimum 75% germination were observed in cultivar T_3 and T_7 under unprotected conditions. For interaction effect on variety and environment is concerned it was noted that interaction of above factor was non significant. However maximum vigour index 1940.40 was noted under protected condition in cultivar T_5 and minimum vigour index 1474.50 were observed in cultivar T_3 under unprotected conditions.

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