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Seasonal abundance of rose pests in relation to weather parameters

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Abstract
The study based on seasonal incidence of rose pest was carried out at Khambhaliya, in Nasari district of Gujarat during 2018-2020. Seasonal incidence of rose pests indicated highest activity of thrips during 19th SMW. Aphid and bud borer larvae remained more active during 6-7th SMW. Higher activity of Castor semilooper was noticed during 24th SMW while, higher activity period of Tussock moth was observed during 40th SMW. Thrips population exhibited positive correlation with temperature (maximum and average) and negative with RH and rainfall. Aphid was negatively influenced by minimum temperature, RH and rainfall. Castor semilooper was directly influenced by temperature while, Tussock moth was directly associated with RH. Bud borer was negatively influenced by temperature (minimum and average) and RH.

Keywords: Seasonal abundance, thrips, aphid, castor semilooper, tussock moth and bud borer

Introduction
Among various ornamental flowers, rose is the most popular and extensively grown flowering shrub throughout the country. The word rose is derived from the name 'Erose' meaning '*The God of love*' which is valued for its beauty, fragrance, varied colours and size. Rose is universally acclaimed as "Queen of Flowers" belonging to the family Rosaceae and is one of the most important ornamental flower species used in landscape and cut flowers the world over. In the international flower market, rose is ranked first among the top three cut flowers *viz*; rose, chrysanthemum and carnation (Hegde, 2010) [6]. Rose is considered as highly valuable ornamental crop for economic benefits providing the best raw material in agro and floriculture industry especially in the production of cosmetics and perfumes. Additionally, rose plays a vital role in the preparation of various products of medicinal and nutritional importance.

The estimated area under rose cultivation and its cut flower production was 29.57 ('000) hectares and 172.294 ('00000) MT, respectively (Anonymous, 2016-2017) [1]. Area and production of rose in Gujarat is 4161 ha with 39049 MT production, respecticvely (Anon;, 2019-2020) [2]. Among the various factors affecting production and quality of flowers, pests and diseases are of prime importance. The most commonly associated pests on rose are *viz*; thrips, *Frankliniella schultzei* (Pergande), *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae); aphid, *Macrosiphum rosae* (Linnaeus) (Hemiptera: Aphididae); whitefly, *Trialeurodes vaporariorum* (Westwood) (Hemiptera: Aleyrodidae); mealybug, *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae); foliage feeders and bud borers, *Helicoverpa armigera* (Hubner); *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae) and mite, *Tetranychus urticae* Koch (Acarina: Tetranychidae) (Dreistadt, 2001; Rajkumar *et al*., 2004) [4, 14]. About sixteen species of insects and one species of mite were observed as pest and associated with various stages of the rose crop in polyhouse (Reddy, 2018) [15]. As not much information is available on abundance of pests on rose in relation to weather factors, this experiment was proposed in 2018 and carried out during 2018-2020.

Materials and Methods
The study based on seasonal abundance of rose pests was carried out at farmers field (latitude: 20.859720, longitude: 73.340308) at Khambhaliya, Ta. Vansda, Dist. Navsari.

Experimental details

Location	Farmers field (Khambhaliya, Ta. Vansda, Dist. Navsari)
Duration	2 years
Year of experimentation	2018-19 & 2019-20
Variety	Gladiator
Plot size	400 m^2
Fertilizer	200:200:200 NPK Kg/ha (Fertilizer application was done as per the recommendation. All the other cultural operations including irrigation was followed as and when required)

Method of recording observation

In order to study the seasonal incidence of pests, regular plot under rose cultivation was selected and observations were recorded at standard week wise interval on 50 plants selected randmly. The observations on pest count were made during two years on each rose plant. The data of two years was summarized and pooled results are mentioned hereunder:

Thrips

Thrips were counted on randomly selected plants by tapping leaves flowers on black paper. Thus, pest population per leaf and flower was assessed (Duraimurugan and Jagadish, 2004) [5].

Aphid

Population count of nymph and adult aphids was done on the plants by selecting three tender shoots of 10 cm length (Hole *et al*., 1997) [7]. Thus, pest population for one shoot per plant was computed.

Foliage feeders and bud borers

Number of larvae of castor semilooper, tussock moth and bud borer was counted on selected plants. The plants were examined thoroughly and absolute population of larvae was recorded at standard week wise interval (Patel and Koshiya, 1997) [11]. The pest population per plant was computed.

Statistical analysis

Relationship between pest population and weather factors was studied using correlation and regression

Results and discussion

Thrips

Pooled results of both the years indicated presence of thrips on rose plants throughout the season except during the rainy season. Thrips population remained low in rainy season as compared to the remaining months. Highest thrips population was noticed (3.37 thrips/leaf & 5.74 thrips/flower) during 19th SMW (Table 1). Thrips population on leaves exhibited positive and highly significant correlation with T_{max} (r = 0.815) and $T_{Av.}$ (r = 0.569) while, it was highly significant but negative correlation with RH (r= -0.487) and rainfall (r= -0.551). Similarly, correlation of thrips on rose flowers and temperature (maximum and average) (T_{max} and $T_{av.}$) (r = 0.822 and 0.557) was positive and highly significant while, it was highly significant but negative with RH (r= -0.510) and rainfall (r= -0.584) (Table 2). Total contribution of all the weather factors on abundance of thrips population on rose leaves and flowers were 69.8 and 72.1 percent indicating significant multiple correlation (R= 0.835 and 0.849), respectively (Table 3). So it is evident from the above results that relationship between correlation between thrips population and temperature was significant and positive implying that with increase in temperature, there was corresponding rise in the pest population and vice-versa. On the other hand, with unit decrease in RH and rainfall, there was corresponding rise in thrips was observed.

Patel (2006) [12] observed thrips on rose flowers throughout the season except in rainy season indicating 8.65 thrips/flower at 23th SMW (June 4-10). Thrips population was reported to exhibit positive correlation with maximum and mean temperatures and negative correlation with relative humidity. Hegde (2010) [6] reported abundance of thrips throughout the flowering period which attained peak during May. Bukero *et al.* (2015) [3] found maximum thrips population (15.78 ± 0.79/leaf) and (18.32 ± 0.86/flower) at 14th SMW (2 -8 April) wherein pest population was negatively correlated with temperature and relative humidity. Similarly, Norboo *et al.* (2017) [10] observed 4.31 thrips/leaf/plant at 14th SMW indicating peak (13.98 thrips/leaf/plant) at 48th SMW. In the earlier reports, higher pest population was recorded during April-June or warmer days. In the present findings, the thrips population remained highest on leaf (3.37 thrips/leaf) and flowers (5.74 thrips/flower) during 19th SMW (7-13 May), the period of warmer days. This indicated significant positive correlation with temperature. So, the present findings are more or less same as reported by earlier workers, however some variation in results may be there due to difference in location and period of experimentation.

Aphid

Appearance of aphid population (3.15 aphids/bud) commenced from 43rd SMW. It increased steadily and attained peak (8.33 aphids/bud) at 6th SMW (Table 1). Aphid population on rose failed to exhibit significant and positive correlation with any abiotic factor whereas, the relationship was significant and negative with $T_{min.}$ (r = -0.466), $T_{av.}$ (r = -0.377), RH (r= -0.332) and rainfall (r= -0.286) (Table 2). The total impact of all weather factors on aphid abundance was 26.7 percent indicating multiple correlation (R) of 0.517 (Table 3). Kmiec (2007) [8] reported first appearance of *Macrosiphum rosae* colonies in different groups of rose in April. Summer disappearance of the colonies was also reported in each year on wild roses. Mehrparvar *et al.* (2008) [9] reported two peaks of aphid in a year, one in May and another in December. Quratulain *et al.* (2015) [13] observed initiation of aphid population in November and another period of increase at the end of February. It indicated more or less similarity in the results of the present investigation with that of above reports which confirm the ongoing discussion. However, there is no published and authentic information available on relationship of aphid population infesting rose with weather factors.

Castor semilooper, *Achaea janata* L.

Castor semilooper in larval form started appearing from 21st SMW indicating population of 0.13 larva/plant. The pest multiplied further indicating peak (0.49 larva/plant) during 24-25th SMW (Table 1). Highly significant and positive correlation of larval population was indicated with $T_{min.}$(r=

0.549), $T_{Av.}$(r = 0.354) and RH (r = 0.456) whereas, no other factor could exhibit significant negative correlation (Table 2). Multiple correlation coefficient (R= 0.764) explained 58.3 percent variation due to all the weather factors (Table 3). Positive correlation between larval population of semilooper with temperature (minimum and average) and RH was indicated which implied that with every unit increase in these parameters there was corresponding increase in the pest population and vice-versa.

Tussock moth, *Orgyia* sp.

Appearance of tussock moth (0.09 larva/plant) on rose plants commenced from 30th SMW which attained peak (0.38 larva/plant) at 40th SMW (Table 1). The results indicated significant positive correlation of tussock moth with RH (r= 0.216) while, no other abiotic factor could indicate significant correlation with the pest population (Table 2). Multiple correlation coefficient (R= 0.607) explained 36.9 percent variation due to all the weather (Table 3). Thus, it may be concluded that larval population of tussock moth increased with unit increase in RH and vice-versa.

Bud borer, *Helicoverpa armigera*

It is evident from the pooled data presented in Table 1 that bud borer, *H. armigera* population started appearing from 24th SMW which reappeared further from 46th SMW indicating highest larval population (0.46 larva/plant) durig 7th SMW.

No abiotic factor could establish significant positive correlation with weather factors however; the relationship was significant and negative with $T_{min.}$ (r = -0.541), $T_{Av.}$ (r = -0.364) and RH (r = -0.535) (Table 2). Multiple correlation coefficient (R= 0.708) explained 50.1 percent variation due to all the weather factors taken into consideration (Table 3). Hegde (2010) [6] reported occurrence of *H. armigera* larvae throughout the year and in higher density from August to October which varied from 0.5 to 2.2 per plant. But in the present findings, the pest larval population was observed twice in a year (24th - 27th & 46th - 12th SMWs). This variation in results from those of earlier workers could be due to difference in location as well as agronomic conditions. Overall, it may be concluded that peak activity of thrips was observed during 17th-19th SMW while, scale insects remained very active during 23rd SMW. Aphid and bud borer *H. armigera* indicated higher activity during 3rd-8th SMW. Castor semilooper and Tussock moth remained very active during 24th-47th SMW. Thrips population was influenced positively by temperature and negatively by RH and rainfall. Aphid was influenced negatively by temperature, RH and rainfall. Scale insect and castor semilooper were directly influenced by temperature while tussock moth was directly associated with RH and indirectly with maximum temperature. Bud borer, *H. armigera* was negatively influenced by temperature, RH and rainfall.

Table 1: Abundance of major pests on rose (2018 -2020)

SMW	Thrips/Leaf	Thrips/Flower	Aphids/Bud	Semilooper larva/Plant	Tussock moth larva/Plant	Bud borerlarva/Plant
15	2.09	1.74	0.00	0.00	0.00	0.00
16	2.17	4.59	0.00	0.00	0.00	0.00
17	2.25	4.72	0.00	0.00	0.00	0.00
18	3.18	5.21	0.00	0.00	0.00	0.00
19	3.37	5.74	0.00	0.00	0.00	0.00
20	3.19	5.62	0.00	0.00	0.00	0.00
21	3.01	5.06	0.00	0.13	0.00	0.00
22	2.70	4.71	0.00	0.33	0.00	0.00
23	2.60	4.07	0.00	0.39	0.00	0.00
24	2.18	3.52	0.00	0.49	0.00	0.07
25	2.13	3.39	0.00	0.49	0.00	0.05
26	1.43	1.82	0.00	0.00	0.00	0.10
27	0.00	0.00	0.00	0.00	0.00	0.06
28	0.15	0.44	0.00	0.05	0.00	0.00
29	0.15	0.45	0.00	0.04	0.00	0.00
30	0.33	0.18	0.00	0.09	0.09	0.00
31	0.52	0.23	0.00	0.07	0.08	0.00
32	0.58	0.66	0.00	0.07	0.09	0.00
33	0.32	0.71	0.00	0.26	0.04	0.00
34	0.40	0.82	0.00	0.15	0.00	0.00
35	0.42	0.99	0.00	0.14	0.00	0.00
36	0.68	0.95	0.00	0.16	0.13	0.00
37	0.85	1.15	0.00	0.16	0.17	0.00
38	1.40	1.89	0.00	0.18	0.24	0.00
39	1.42	2.09	0.00	0.29	0.31	0.00
40	1.96	2.71	0.00	0.22	0.38	0.00
41	2.55	3.42	0.00	0.10	0.29	0.00
42	2.72	3.90	0.00	0.00	0.16	0.00
43	0.62	1.86	3.15	0.00	0.15	0.00
44	0.72	2.15	5.18	0.00	0.21	0.00
45	1.09	2.92	6.15	0.00	0.23	0.00
46	1.09	2.74	7.12	0.00	0.31	0.07
47	1.22	2.81	7.21	0.00	0.34	0.16
48	1.35	2.75	5.75	0.00	0.32	0.15
49	1.64	2.94	4.08	0.00	0.25	0.15
50	1.52	2.95	3.72	0.00	0.21	0.14

51	1.48	3.01	0.00	0.00	0.12	0.17
52	0.92	1.26	0.00	0.00	0.00	0.14
1	0.88	1.13	0.00	0.00	0.00	0.12
2	0.73	0.26	0.00	0.00	0.00	0.00
3	0.96	1.21	1.33	0.00	0.00	0.00
4	1.25	2.00	3.47	0.00	0.00	0.07
5	1.48	2.73	5.58	0.00	0.00	0.11
6	1.72	3.02	8.33	0.00	0.00	0.26
7	1.38	1.79	4.16	0.00	0.00	0.46
8	1.85	3.08	0.00	0.00	0.00	0.38
9	2.14	3.79	0.00	0.00	0.00	0.25
10	2.38	4.31	0.00	0.00	0.00	0.18
11	1.93	2.56	0.00	0.00	0.00	0.19
12	2.56	4.29	0.00	0.00	0.00	0.11
Mean	1.51	2.53	1.30	0.08	0.08	0.07

Table 2: Correlation coefficients of rose pests in relation to weather parameters (2018-2020)

Parameters	Correlation Coefficients					
	Thrips/Leaf	Thrips/Flower	Aphids/Bud	Semilooper larva/Plant	Tussock moth larva/Plant	Bud borer larva/Plant
T_{max} (°C)	0.815**	0.822**	-0.084	-0.043	-0.237	0.042
T_{min} (°C)	0.146	0.123	-0.466**	0.549**	-0.044	-0.541**
T_{Av} (°C)	0.569**	0.557**	-0.377*	0.354*	-0.162	-0.364**
RH (%)	-0.487**	-0.510**	-0.332**	0.456**	0.216**	-0.535**
Rainfall (mm/day)	-0.551**	-0.584**	-0.286*	0.097	-0.122	-0.253

*Significant (p = 0.05)
**Significant (p = 0.01)

Table 3: Regression coefficients of rose pests in relation to weather parameters (2018-2020)

Parameters	Regression Coefficients					
	Thrips/Leaf	Thrips/Flower	Aphids/Bud	Semilooper larva/Plant	Tussock moth larva/Plant	Bud borer larva/Plant
T_{max} (°C)	0.211	0.324	-1.834	0.000	-0.007	-0.053
T_{min} (°C)	0.108	0.159	-0.869	0.145	-0.100	0.039
T_{Av} (°C)	-0.136	-0.172	2.391	-0.130	0.095	0.005
RH (%)	0.000	0.000	-0.148	-0.009	0.013	-0.013
Rainfall (mm/day)	-0.029	-0.059	-0.083	-0.011	-0.007	0.001
Constant (A)	-4.054	-6.716	26.462	1.010	-0.813	1.637
R^2	0.698	0.721	0.267	0.583	0.369	0.501
Variation (%)	69.8	72.1	26.7	58.3	36.9	50.1
R	0.835	0.849	0.517	0.764	0.607	0.708

Conclusion

So, it may be conluded that peak activity of thrips was observed during 17-19 SMW while, scale insects remained very active during 23rd SMW. Aphid and bud borer indicated higher activity during 6-7 SMW. Castor semilooper and Tussock moth remained very active during 24-47 SMW. Thrips population was influenced positively by temperature and negatively by RH and rainfall. Aphid was influenced negatively by temperature, RH and rainfall.

Scale insect and castor semilooper were directly influenced by temperature while, Tussock moth was directly associated with RH and indirectly with maximum temperature. Bud borer was negatively influenced by temperature, RH and rainfall.

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