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Studies on the seasonal occurrence and control of pomegranate (Punica granatum), (Lythraceae) insect pests, with a focus on fruit borer and thrips

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Abstract
The current study on "Studies on seasonal incidence and management of insect pests of pomegranate, *Punica granatum* (Lythraceae), with special reference to fruit borer and thrips" was carried out at the Dry Land Horticulture Research Farm, Pt. Shiv Kumar Shastri College of Agriculture & Research Station, Surgi; district Rajnandgaon, during the kharif-rabi, 2020-21. Twenty-four insect pests were identified causing damage to pomegranate at various growth stages in pest succession studies. On the pomegranate environment, five sucking pests (aphid, thrips, whitefly, mealy bug, and mites), one fruit borer (anar butterfly), and three leaf defoliators (castor semi-looper, tussock moth caterpillar, and hairy caterpillar) predominated. Thrips, *Scirtothrips* sp., and fruit borer, *Deudorix* sp. were identified as important pomegranate insect pests. Based on the pooled mean, Neem Seed Kernel Extract (NSKE) @ 5% outperformed other botanical insecticides in terms of thrips and fruit borer infestation, with 2.11 thrips/5 cm shoot and 4.96 percent, respectively.

Keywords: Pomegranate, *Punica granatum*, thrips, *Scirtothrips* sp, fruit borer, *Virachola*, *Deudorix*, botanical insecticide, pest management

Introduction
Pomegranate (*Punica granatum* L.) is a member of the Punicaceae family. Pomegranate gets its name from the Latin words pomum (=apple) and granatum (= seeded). It is a popular table fruit in tropical and subtropical climates. The fruit is indigenous to Iran and is widely grown in Mediterranean nations such as Spain, Morocco, Egypt, and Afghanistan. It is also grown to some extent in Burma, China, Japan, the United States, and India. India leads the globe in pomegranate farming (Balikai *et al.*, 2011) [19]. In India, it is regarded as “vital cash crop”, grown in an area of 1,43, 140 ha with a production of 17,73,660 MT and average productivity of 12.39 MT (Anon, 2015).

Pomegranates are spherical, crimson fruits that are in colour. They contain a white internal flesh that is crammed full of arils, which are edible seeds that are crisp and delicious. Although they are most well-known for the vividly coloured juice that they are usually used in, these odd fruits have a lot more to offer.

The butterfly, *Virachola Isocrates* Fab, is the most annoying foe of the pomegranate tree. According to Balikai *et al.* (2011) [19], this might damage more than 50% of the fruits. Pomegranate losses from mealy bugs, a significant pest, were 46.66% in 2019, according to Sahu *et al.* Infestations by sucking pests occur throughout the crop's flowering and fruiting stages, which decreases the plant's vigour in addition to the production of honeydew on the leaves and the growth of sooty mould on the leaves and fruits (Dong *et al.*, 2014) [20].

Thrips (*Scirtothrips dorsalis* Hood.) nymphs and adults both eat by sucking and rasping with their mouthparts. They lacerate the growing fruiting portions' surfaces, which results in deformation that gives the fruits a corky look and lower prices on the domestic market and rejection for export. Thrips, *Scirtothrips dorsalis* H., is one of the most significant pests affecting the pomegranate crop, according to Gilbert (1986) [21]. It consumes fruits and foliage, lowering the quality of the fruits as a result. Thrips are regarded as a possible pest in pomegranates on a global scale since they are in charge of lowering fruit quality. In India, losses ranging from 40% to 90% on average have been recorded.

No systematic investigation on the relationship between insect pests in pomegranates and their control has been done in the Rajnandgaon district of Chhattisgarh state in the last year. In order to offer information on the status and losses brought on by various insect pests, the current study was undertaken to gather information on the seasonal occurrence of insect pests on pomegranates. This information helps in developing an efficient management model for the insect pests attacking at various stages of crop.

Materials and Methods

During the kharif rabi of 2021–2022, field tests were conducted at the Dry Land Horticulture Research Farm, Pt. SKS College of Agriculture & Research Station, Surgi, Rajnandgaon. Fruit borer populations on the *Bhagwa* variety of pomegranate were gathered at weekly intervals in order to determine the seasonal incidence of insect pests associated with the pomegranate crop.

By shaking five randomly chosen new shoots (each measuring 5 cm in length) from each of the four directions (E, W, N, and S) of each plant and counting the number of nymphs and adults that emerged, the population of thrips was determined. One day prior to spraying as well as three, seven, and ten days thereafter, observations of thrips were made.

To count the damaged and healthy fruits for determination of fruit borer population, five plants were randomly chosen at weekly intervals. Fruits with active holes on them during fruiting season were shown to have a weekly population of fruit borer larvae. For the pomegranate fruit borer, observations were made one day prior to spraying as well as seven, fourteen, and twenty-one days thereafter.

A knapsack sprayer (15-liter capacity) was used to apply all non-insecticide products as foliar sprays. To ascertain the bio-efficacy of non-insecticidal treatments against the main insect-pests of pomegranate, a morning experiment was conducted. Only water was used to spray the control plots. Measured amounts of water and a non-insecticide substance were combined to create the spray fluid. When administering each treatment, the appropriate safety precautions were taken. Spraying was carried out when the target insect pest population was sufficiently large in the field.

A. Details of Technical Programme

Crop	Pomegranate
Date of Planting	January, 2017
Planting Distance (Row × Plant)	5m ×5m
Year	2021-22
Season	*Kharif – Rabi*
Total Plot Size	0.64 hac.
Total no. of Plant/Row	08
No. of rows/plot	12
Variety	*Bhagwa*
No. of selected plants/variety	10 plants
Observational Direction	North, South, East, West

B. Treatment details

Treatments	Non–insecticide
T1	Neem oil (2%)
T2	Karanj oil (2%)
T3	Neem Seed Kernel Extract (5%)
T4	Karanj seed extract (2.5%)
T5	Green Chilli (10kg/ha)
T6	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC @ 1.5%
T7	Untreated check

Result and Discussion

Thrips, *Scirtothrips* sp.

The thrips population observed prior to spraying showed no significant variations across the treatments, indicating that the thrips population was homogeneous, as shown in the Table 1.1.

Population of thrips after first spray

Thrips populations were counted three, seven, and ten days after spraying in various treatments. Despite the fact that the typical check insecticide, Thiamethoxam 12.6%+ Lambdacyhalothrin 9.5% ZC was discovered to be superior after each spray of treatments. At 3 days after spray, Neem Seed Kernel Extract (NSKE) @ 5% was found to be superior against thrips population, with a significantly lower population of 2.04 thrips/5 cm shoot, followed by Green chilli @ 10 Kg/ha with 2.41 thrips/5 cm shoot, which is comparable to the other treatments except the untreated control. At 7 days after spraying, NSKE @ 5% delivered a much lower population of 2.15 thrips/5 cm shoot, which was comparable to the other treatments except the untreated control. At 10 days after spraying, the treatment NSKE @ 5% had the lowest population of 2.05 thrips/5 cm shoot, which was significantly superior to all other treatments. Except for the untreated control, the other treatments were comparable.

Population of thrips after second spray

There were no significant variations in thrips population before the second spray across the treatments. At 3 days after spraying, Neem Seed Kernel Extract (NSKE) @ 5% was found to be considerably superior to a minimum population of 2.53 thrips/5cm shoot. Karanj Seed Extract (KSE) @ 2.5% scored 2.63 thrips/5cm shoot, which was comparable to Green chilli 10 kg/ha and Karanj oil 2%, which scored 2.68 and 2.69 thrips/5cm shoot, respectively. Except for the untreated control, all treatments were superior. At 7 days after spraying,

Neem Seed Kernel Extract (NSKE) @ 5% again outperformed all other treatments except the untreated control in lowering the population of 1.89 thrips/5 cm shoot. Similarly, Neem Seed Kernel Extract (NSKE) @ 5% worked best in lowering the population of 1.66 thrips/5 cm shoot at 10 days after spray, which was statistically superior to other botanicals. All treatments were shown to be significantly better than the untreated control.

Population of thrips after third spray

Thrips populations were homogeneous across treatments before the third spray. Neem Seed Kernel Extract (NSKE) @ 5% was shown to be the most effective treatment among the botanicals in terms of thrips population reduction, with 3.03, 2.51, and 1.12 thrips/5 cm shoot at 3, 7, and 10 days after spraying. Other botanicals, on the other hand, were on par with one another and found to be superior to the untreated control after 3, 7, and 10 days after spray. In comparison to other botanical insecticides, Neem Seed Kernel Extract (NSKE) @ 5% discovered superior recording substantial lowest population of thrips with 2.11 thrips/5 cm shoot on the basis of pooled mean. The remaining botanicals were comparable and determined to be superior to the untreated control. In India, Verghese *et al.* (2001) [22] discovered that NSKE @ 5% was superior against S. dorsalis (0.34 thrips/tree) on pomegranate trees, followed by Karanj seed extract @ 5% and Karanj oil @ 1% with 0.52 and 0.54 thrips/tree, respectively. This conclusion is consistent with the current one, in which treatment NSKE @ 5% was found to have the lowest population of thrips (2.11 thrips/5 cm shoot), followed by Karanj seed extract @ 2.5% (2.29 thrips/5 cm shoot).According to Balakrishanan *et al.* (2016) [23], the efficacy of bio-pesticides against thrips revealed that Spinosad 45% SC (0.0125%) was superior and effective against pomegranate thrips (55.3%), followed by NSKE @ 5% (52.0%), and Azadirachtin 10000 ppm (0.02%) (51.7%) at 14 hours after treatment. This finding is supported by the current investigation.

Fruit borer, *Deudorix* sp. Fabricius

The percent fruit borer infestations among all the treatments were non-significant, which means the fruit borer infestation were homogenous among all the treatments.

Infestation of fruit borer after spray

Fruit borer infection was measured at 7, 14, and 21 days after different treatments were sprayed. Despite the fact that the usual check insecticide, Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC @ 1.5%, was determined to be superior after 7, 14, and 21 days after spraying. Among the botanicals, at 7 days after spray, Neem Seed Kernel Extract (NSKE) @ 5% had the lowest fruit borer infection (7.00%), which was statistically comparable to the other botanicals except Karanj seed Extract @ 2.5%. All treatments outperformed the untreated control. At 14 days after spraying, Neem Seed Kernel Extract (NSKE) @ 5% was found to give significantly less fruit borer infestation with 4.04 percent fruit infestation, which was statistically comparable to Green chilli @ 10 kg/ha with 4.20 percent fruit infestation. The remaining botanicals were comparable to one another and superior to the untreated control. However, after 21 days following spray, a similar significantly lower fruit borer infestation (3.84%) was documented against Neem Seed Kernel Extract (NSKE) @ 5%, which was significantly lower than Green chilli @ 10 kg/ha with 4.22 percent, which was lower than the rest of the botanicals. Based on the pooled mean, among the botanicals, Neem Seed Kernel Extract (NSKE) @ 5% performed best, with 4.96% fruit infestation, followed by Green chilli @ 10 kg/ha with 5.15 percent fruit infestation. Other botanicals, such as Neem oil 2%, Karanj oil 2%, and Karanj Seed Extract @ 2.5%, performed equally well and outperformed the untreated control. Sharjana *et al.* (2018) [24] conducted a botanical management of fruit borer trial in Sri Lanka and reported that NSKE @ 3% reduced the population of *Deudorix Isocrates* the most, followed by Neem oil @ 1%. This finding is consistent with the current one, in which treatment NSKE @ 5% was determined to be the most effective botanical treatment against fruit borer infestation at 7, 14, and 21 days following treatment. Mikuunthan *et al.* (2019) findings were consistent with the current investigation. They discovered that NSKE @ 1% (0.34%) had the lowest population of fruit borers, followed by NSKE @ 3% (0.40%) and Neem leaf extract (2.5 ml/L) with 0.40 and 1.12%, respectively.

Table 1.1: Bio-efficacy of non-insecticidal treatments against thrips on pomegranate during *kharif-rabi*, 2021-22

Tr. No.	Treatments	Dose	Average reduction of thrips population															
			1st spray				Mean	2nd spray				Mean	3rd spray				Mean	Pooled mean
			PTC	3DAT	7DAT	10DAT		PTC	3DAT	7DAT	10DAT		PTC	3DAT	7DAT	10DAT		
T_1	Neem oil	2%	3.29 (2.07)	2.74 (1.93)d	2.38 (1.84)c	2.42 (1.85)cd	2.51 (1.69)	3.28 (2.07)	2.72 (1.93)d	2.03 (1.74)bc	1.80 (1.67) cd	2.18 (1.66)	4.03 (2.23)	3.17 (2.04) cd	2.76 (1.94) d	1.30 (1.52) cd	2.41 (1.68)	2.37 (1.83)
T_2	Karanj oil	2%	3.30 (2.07)	2.45 (1.86)cd	2.28 (1.81)bc	2.38 (1.84)c	2.37 (1.68)	3.29 (2.07)	2.69 (1.92)cd	2.06 (1.75)bc	1.77 (1.66) c	2.17 (1.66)	3.98 (2.23)	3.16 (2.04)cd	2.76 (1.94)cd	1.29 (1.51)cd	2.40 (1.68)	2.31 (1.81)
T_3	Neem Seed Kernel Extract (NSKE)	5%	3.31 (2.07)	2.04 (1.74)b	2.15 (1.78)b	2.05 (1.75)b	2.08 (1.66)	3.31 (2.07)	2.53 (1.88)b	1.89 (1.70) b	1.66 (1.63) b	2.03 (1.65)	3.98 (2.23)	3.03 (2.00)b	2.76 (1.94)b	1.12 (1.46)b	2.22 (1.67)	2.11 (1.76)
T_4	Karanj Seed Extract (KSE)	2.50%	3.30 (2.07)	2.43 (1.85)cd	2.27 (1.80)bc	2.39 (1.84)c	2.36 (1.68)	3.29 (2.07)	2.63 (1.91)c	2.01 (1.74) bc	1.80 (1.67) cd	2.15 (1.66)	4.00 (2.24)	3.18 (2.04)cd	2.76 (1.94)c	1.24 (1.50)c	2.36 (1.68)	2.29 (1.81)
T_5	Green chilli	10 kg/ha	3.29 (2.07)	2.41 (1.84)c	2.30 (1.82)bc	2.38 (1.84)c	2.36 (1.68)	3.26 (2.06)	2.68 (1.91)c	2.07 (1.75)bc	1.80 (1.67)cd	2.18 (1.66)	3.97 (2.23)	3.15 (2.03)c	2.76 (1.94)c	1.27 (1.51)cd	2.37 (1.68)	2.30 (1.81)
T_6	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	1.5 ml/L	3.28 (2.07)	1.15 (1.46)a	0.98 (1.41)a	0.34 (1.16)a	0.82 (1.53)	3.29 (2.07)	2.03 (1.74)a	1.04 (1.43)a	0.78 (1.33)a	1.28 (1.58)	3.98 (2.23)	1.23 (1.49)a	2.76 1.94)	0.00 (1.00)a	0.69 (1.56)	0.93 (1.44)
T_7	Untreated check	-	3.32 (2.08)	2.70 (1.92)d	2.72 (1.93)d	2.77 (1.94)e	2.73 (1.71)	3.26 (2.06)	2.98 (1.99)e	2.76 (1.94)d	1.97 (1.72)e	2.57 (1.69)	3.97 (2.23)	3.51 (2.12)e	2.76 (1.94)e	3.04 (2.01)e	3.22 (1.73)	2.72 (1.94)
Se(m)		-	0.005	0.016	0.014	0.01	0.012	0.005	0.004	0.022	0.008	0.008	0.005	0.007	2.76(1.94)	0.006	0.029	0.003
C.D.		-	NS	0.05	0.043	0.03	0.038	NS	0.013	0.007	0.025	0.026	NS	0.021	2.76(1.94)	0.019	0.090	0.008

PTC = Pre-treatment count of aphids population, DAT = Day After Treatment, SEM = Standard Error Mean, CD = Critical Difference

Table 1.2: Efficacy of non-insecticidal treatments against fruit borer on pomegranate during *kharif-rabi*, 2021-22

Tr. No.	Treatments	Dose	Percent reduction in fruit borer population				
			PTC	7DAT	14DAT	21DAT	Pooled mean
T_1	Neem oil	2%	10.26 (3.35)	6.15 (2.67) bc	4.13 (2.27) bc	3.31 (2.07) bc	4.53 (2.34) d
T_2	Karanj oil	2%	10.30 (3.36)	6.11 (2.67) bc	4.19 (2.28) bc	3.32 (2.08) cd	4.54 (2.34) d
T_3	Neem Seed Kernel Extract (NSKE)	5%	10.28 (3.36)	6.00 (2.65) b	4.04 (2.24) b	2.84 (1.96) b	4.29 (2.28) b
T_4	Karanj Seed Extract (KSE)	2.5%L	10.25 (3.35)	6.21 (2.68) bc	4.15 (2.27) bc	3.29 (2.07) bc	4.55 (2.34) d
T_5	Green chilli	10 kg/ha	10.32 (3.36)	6.04 (2.65) b	4.20 (2.28) bc	3.22 (2.05) bc	4.49 (2.33) c
T_6	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	1.5 ml/L	10.26 (3.35)	5.05 (2.46) a	3.28 (1.89) a	2.31 (1.82) a	3.55 (2.12) a
T_7	Untreated check	-	10.34 (3.37)	6.58 (2.75) cd	4.97 (2.44) d	4.00 (2.23) e	5.18 (2.48) e
Se(m)		-	0.005	0.026	0.025	0.034	0.017
CD		-	NS	0.081	0.079	0.107	0.053

PTC = Pre treatment count of aphids population DAT = Day after treatment, SEM = Standard error mean CD = Critical difference

Conclusion

Among all the non-insecticide products Neem Seed Kernel Extract @ 5% (NSKE) was found most effect against thrips and fruit borer population followed by Karanj Seed Extract @ 2.5% and Green Chilli @ 10 Kg/ha. Hence, plant product NSKE was found superior over all the other non-insecticidal treatment after the standard treatment.

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