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Abundance of Sap Sucking Insect Pests of Mulberry (*Morus Alba* L.) In Khammam district of Telangana state, India

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Abstract

The goal of the current study is to record the effects of up to six agronomic practices (T1–T6), based on farmer-level conditions as they exist, on the abundance of five significant mulberry sap sucking insect pests in the mulberry gardens of all sericulture farmers randomly selected in the Khammam District between 2019–20 and 2021–22 (3 years). The following are sap-sucking pests that were selected to track the abundance in the mulberry gardens of the identified farmers: 1) thrips (*Pseudodendrothrips mori*), 2) jassid (*Empoasca flavescens*), 3) scale insect (*Saissetia nigra*), 4) pink mealy bug (*Maconellicoccus hirsutus*), and 5) spiralling white fly (*Aleurodicus dispersus*). The highest concentration of sucking insect pests (spiraling white fly, mealy bug, jassid, scale insect, and thrips) was seen in T4, while the lowest concentration was found in T6. In most treatments, T2, which was equipped with tillage, closer spacing, and inorganic inputs, held the second position in terms of abundance. The quantity of sucking pests was as follows: T4<T2<T1<T5<T3<T6, which corresponded to the pests' incidence regardless of the season or length of monitoring.

Keywords: *Morus alba*, insect pests, Abundance, mulberry

Introduction

The production of high-quality silk is essential to the sericulture industry's survival and development. *Bombyx mori* L.'s only food plant, quality mulberry leaves, are what silkworm larvae need to eat in order to produce high-quality cocoons and silk (Muzamil *et al*, 2023) [7] The assault of several insect and non-insect pests is negatively affecting the mulberry leaf producing process. Being a high biomass generating perennial bloomer, it grows luxuriantly when watered according to specified packaging and methods, which frequently encourages the reproduction and spread of several pests. This situation causes pests to multiply quickly, which in turn causes mulberry plant losses both in terms of number and quality, and eventually results in low output in sericulture (Lin Z *et al*, 2022) [4].

The majority of farmers struggled with ignorance when it came to managing pests and diseases in mulberry fields (Malathesh *et al*, 2009) [5]. One of the major sucking pests on mulberry leaves are thrips, whiteflies, and wide mites (Monchan *et al*, 2008) [6].

A pest's infestation and population growth are significantly influenced by meteorological factors such as temperature, relative humidity, rainfall, and others. Additionally, the ability of insect pests to survive, develop, and reproduce is strongly influenced by climate (Skendzic*et al*., 2021) [10]. A number of illnesses and pests have been identified in recent years as the main causes restricting mulberry leaf output as a result of intensive farming methods and the careless use of nitrogenous fertilizers and pesticides. Because of changes in the agro environment and climate, the situation of insect pests in mulberries has changed. In addition to the afore mentioned methods, monoculture and the use of high-yielding cultivars also contributed to pest issues, with minor pests growing into major ones (Pretty J*et al*, 2015) [9].

The straight, cylindrical trunk of the medium-sized tree *Morus alba* grows quickly and has a circumference of 1.8 meters without the need for buttresses. According to Batiha *et al*. (2023) [1], the latex is white or yellowish white, and the bark has longitudinal fractures and a rough surface. The bark is dark grayish brown in hue. With two rows of oval or almost oval leaves and a basic trilobal, dentate, and palm with three veins at the base, the stem is lateral, scaly, and coral. The flowers have four free scale-like petals with a greenish tint. Four pistil-shaped stamens; male; loose raceme fowers resembling catkins. Female fowers with two styles, one ovule, one chamber, ovarian blockage, long or short spikes, and a fan-shaped ovule. a single ovule and an ovary shaped like a fan. Feshy perianths up to 5 cm long encircle certain drupes in this ovarian syncarpous fruit (Orwa *et al*, 2009) [8].

Methodology

The present study was conducted in the Khammam District of Telangana State, India, from 2019–20 to 2021–22. Based on the pest's nature (sap sucking), an estimate of the population of insects was made (Chintalapati *et al*., 2020) [3]. In the current investigation, efforts have been made to document the effects of up to six agronomic practices/packages (T1-T6) on the abundance of five significant sap sucking insect pests of mulberry in the selected mulberry gardens of a total of 120 sericulture farmers drawn at random from 2019–20 to 2021–22 (3 years). This documentation is based on conditions at the farmers' level.

T1 = Tillage + tighter spacing + organic inputs in gardens
T2 = Tillage + tighter spacing + inorganic fertilizers
T3 = Tillage + tighter spacing + organic + inorganic inputs in gardens
T4 = Wider spacing, no tillage, and organic fertilizers
T5 = Wider spacing + Inorganic inputs + No tillage gardens
T6 = Wider spacing, no tillage, organic and inorganic inputs, and gardens.

Monthly data were gathered from 20 mulberry gardens for every treatment, and the results are shown as mean ± Standard error (M ± SE). The three seasons are summer (March-June), winter (November-February), and rainy

(July-October). The following insect pests were selected to track the quantity in the identified farmers' mulberry gardens:

The following are sap-sucking pests: 1) jassid (*Empoasca flavescens*), 2) thrips (*Pseudodendrothrips mori*), 3) scale insect (*Saissetia nigra*), 4) pink mealy bug (*Maconellicoccus hirsutus*), and 5) spiraling white fly (*Aleurodicus dispersus*).

Results and discussion

A profusion of mulberry bugs that feed on sap (Morus rubra)

Pseudodendrothrips mori (numbers/ leaf)

In the summer, rainy, and winter seasons of 2019–20, the mean abundance of *Pseudodendrothrips mori* varied from 9.91 ± 0.35 (T2) to 3.18 ± 0.30 (T6); 8.76 ± 0.42 (T2) to 2.34 ±0.28 (T6); and 10.86 ± 0.34 (T6) to 4.08 ± 0.27 (T6), respectively. In 2020–21, the summer and rainy seasons yielded the highest values at 11.55 ± 0.42 (T2) and 9.44 ± 0.30 (T2), respectively; the corresponding lowest values were 5.27 ± 0.41 (T6) and 2.94 ± 0.29 (T6); in the winter, T4 and T6 showed the greatest (11.50 ± 0.29) and lowest (4.55 ± 0.28) pest abundance. Regarding 2021–2022, the pest abundance peaked in T4 during the summer (12.52 ± 0.36), during the rainy season (9.42 ± 0.35), and during the winter (9.72 ± 0.43), respectively, and peaked in T6 at 6.48 ± 0.42, 2.93 ± 0.32, and 1.96 ± 0.32. It was noticed from the pooled data that the mean values were highest in T4 during 2021–22, whereas they were lowest in T2 during 2019–20 and 2020–21. The majority of treatments showed a significant difference ($P \leq 0.01$) when the mean values were compared. The pest abundance declined in the following sequence, except 2021–2022, T2<T4<T1\T5\T3<T6; in 2021–2022, the decreasing order was T4<T2\T1\T5\T3<T6 (Fig 1, 2).

Fig 1: *Pseudodendrothrips mori*

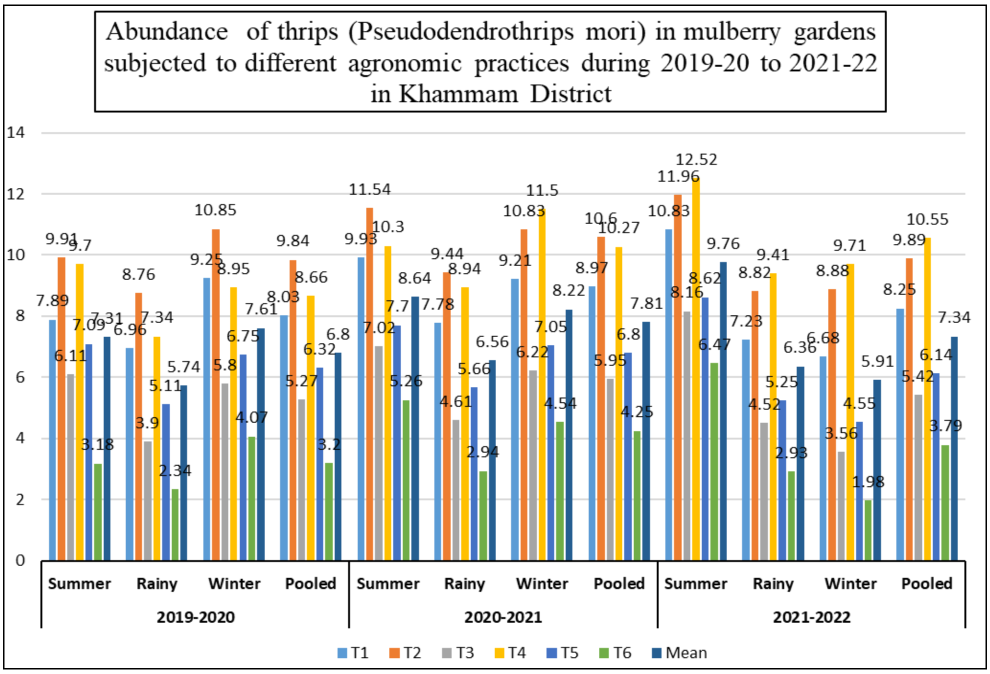

Fig 2: Graphical representation of the Thrips (*Pseudodendrothrips mori*) in abundance in Khammam District mulberry gardens from 2019–20 to 2021–22

***Empoasca flavescens* (numbers/leaf):**

The mean values for the parameter in T4, T6, and T3 were 2.85 ± 0.30, 3.03 ± 0.35, and 4.16 ± 0.28, respectively, while in T4 they were 7.68± 0.47, 7.78 ± 0.58, and 8.48 ± 0.59. In 2020–21, T4 recorded the highest pest abundance of *Empoasca flavescens* in the summer, rainy, and winter seasons (7.54 ± 0.46, 6.64 ± 0.47, and 7.17 ± 0.40, respectively). T6 recorded the lowest values, with 3.72 ± 0.33, 2.41 ± 0.38, and 3.13 ± 0.17, respectively. During the summer, rainy, and winter seasons of 2021–22, the pest abundance was highest in T4 and lowest in T6, with mean values ranging from 7.95 ± 0.50 to 4.22 ± 0.34, 5.97 ± 0.50 to 1.93 ± 0.31, and 6.56 ± 0.56 to 1.78 ± 0.35, respectively. When statistical analysis was performed on the mean results, most treatments showed significant variation (P ≤ 0.01). During the pest monitoring period, the treatments' decreasing order of pest abundance was T4<T2<T1<T5<T3<T6 (Fig 3, 4).

Fig 3: *Empoasca flavescens*

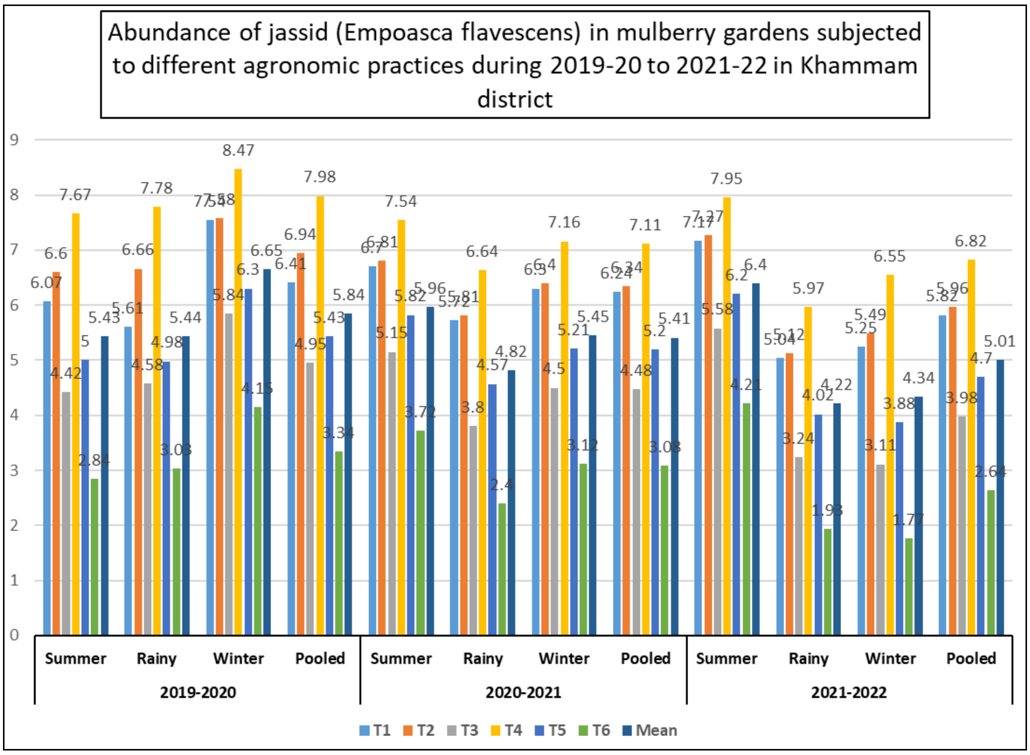

Fig 4: graphical representation of the Abundance of jassid (*Empoasca flavescens*) in mulberry gardens during 2019-20 to 2021-22 in Khammam district

***Saissetia nigra* (numbers/plant)**

The following was shown by the parameter's mean data in Fig 6: The mean abundance of *Saissetia nigra* (Fig 5) varied from 7.38 ±0.49 to 2.20 ± 0.35 in the summer, from 7.02 ± 0.53 to 2.76 ± 0.43 in the winter, and from 7.43 ± 0.50 to 4.14 ± 0.38 in the rainy season in 2019–20. The highest values were obtained in T4 and the lowest in T6. The mean values for the summer, rainy, and winter seasons in 2020–21 were 6.11 ± 0.26 & 3.84 ± 0.46, 5.88 ± 0.48 & 1.87, and 6.97 ± 0.37 & 3.22 ± 0.36. The highest and lowest values were scored in T5 and T1. With maximum and minimum results ranging from 8.08 ± 0.51 to 4.60 ± 0.60 and from 4.64 ± 0.51 to 2.45 ± 0.38, the observations recorded during the summer and rainy seasons of 2021–22 also aligned with those of 2020–21. The pest abundance in the winter varied from 4.50 ± 0.58 (T4) to 2.37 ± 0.52 (T5) as was scored during 2019–20. When statistical analysis was performed on the mean data, it was shown that there was a highly significant variation (P ≤ 0.01) in the pest abundance among the treatments. T4<T2<T1<T5<T3<T6 was the decreasing order of pest abundance in 2019–20; in 2020–21, it was T5<T3<T4<T6<T2<T1; in 2021–22, throughout the summer and rainy seasons, T5<T3<T4<T6<T2<T1, and in the winter, T4<T5<T2<T3<T1<T6.

Fig 5: *Saissetia nigra*

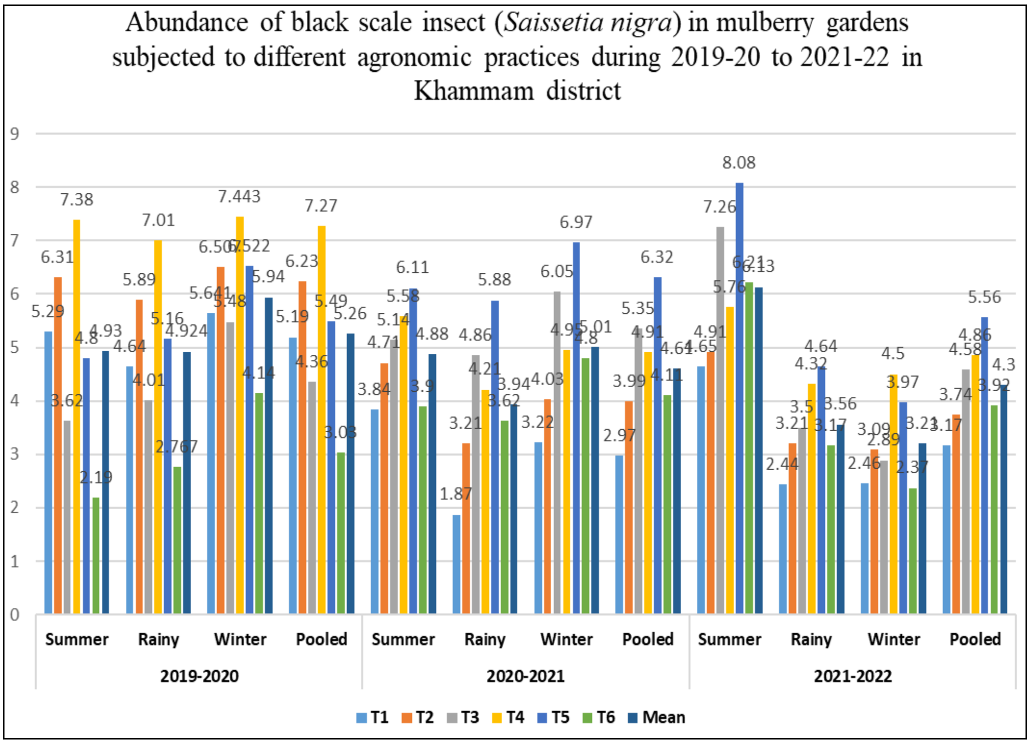

Fig 6: graphical representation of the Abundance of black scale insect (*Saissetia nigra*) in mulberry gardens during 2019-20 to 2021-22 in Khammam district

Maconellicoccus hirsutus **(numbers/plant)**

In the summer, rainy, and winter seasons, respectively, the abundance of *Maconellicoccus hirsutus* varied from 12.36 ± 0.54 to 4.28 ± 0.36, from 11.35 ± 0.66 to 3.83 ± 0.45, and from 13.06 ± 0.39 to 5.43 ± 0.32. The seasons with the highest and lowest abundance were T4 and T6. The mean data for the summer, rainy, and winter seasons in 2020–21 ranged from 13.18 ± 0.40 to 6.46 ± 0.34, 12.06 ± 0.53 to 5.16 ± 0.47, and 10.63 ± 0.31 to 5.73 ± 0.26, respectively, with T4 and T6 scoring the highest and lowest values.

Similar findings were also seen in 2020–21, with the summer, rainy, and winter seasons' greatest and lowest values being 13.18 ± 0.40 & 6.46 ± 0.34, 12.06 ± 0.53 & 5.16 ± 0.47, and 10.63 ± 0.31 & 5.73 ± 0.26, respectively. The data collected in 2021–22 was consistent with that of the previous years (2019–2021), with T4 showing the highest values and T6 the lowest. The mean results varied from 11.62 ± 0.40 to 6.87 ± 0.31, from 9.57 ± 0.37 to 4.68 ± 0.31, and from 10.04 ± 0.56 to 4.10 ± 0.43 in the summer, rainy, and winter seasons. The majority of the treatments showed substantial variation (P < 0.01) in the mean findings. T4<T2<T1<T5<T3<T6 was the decreasing order of pest abundance among treatments (Fig 7, 8).

Fig 7: *Maconellicoccus hirsutus*

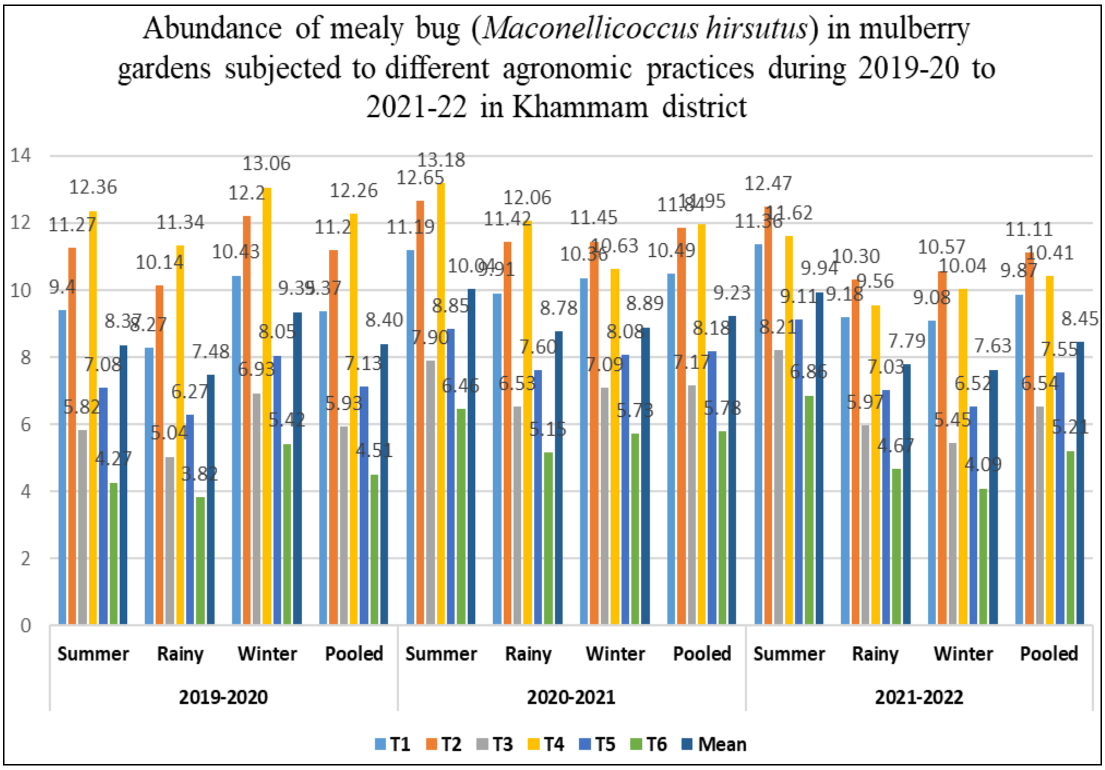

Fig 8: Graphical representation of the Abundance of mealy bug (*Maconellicoccus hirsutus*) in mulberry gardens during 2019-20 to 2021-22 in Khammam district

Aleurodicus dispersus **(numbers/leaf)**

Throughout 2019–20, the pest abundance was highest in T4 and lowest in T6, with mean values shifting in summer, rainy, and winter, respectively, from 3.51 ± 0.15 to 0.90 ± 0.06, from 10.41 ± 0.62 to 2.88 ± 0.40, and from 10.94 ± 0.35 to 3.46 ± 0.25. In 2020–21, T4 and T6 had the highest and lowest pest abundance in the summer and rainy seasons, respectively, with values ranging from 3.48 ± 0.14 to 1.28 ± 0.14 and from 9.27 ± 0.42 to 2.34 ± 0.39. However, T2 had the highest pest abundance during the winter, scoring 9.01 ±

0.26, while T6 had the lowest (3.11 ± 0.16). In comparison to T6, which scored the lowest mean abundance of 1.67 ± 0.14, 1.87 ± 0.31, and 1.70 ± 0.34, T2 had the highest abundance of *Aleurodicus dispersus* for the 2014–15 season, with mean data for the summer, rainy, and winter seasons being 3.31 ± 0.13, 7.61 ± 0.40, and 8.07 ± 0.46. Upon data analysis, the majority of treatments showed a significant variance (P ≤ 0.01). The declining order of pest abundance was T4<T2<T1<T5<T3<T6 in the summer and rainy seasons of 2019–20 and 2020–21, and T2<T4<T1<T5<T3<T6 in the winter of 2020–21 and 2021–22 (Fig 9, 10).

Fig 9: *Aleurodicus disperses*

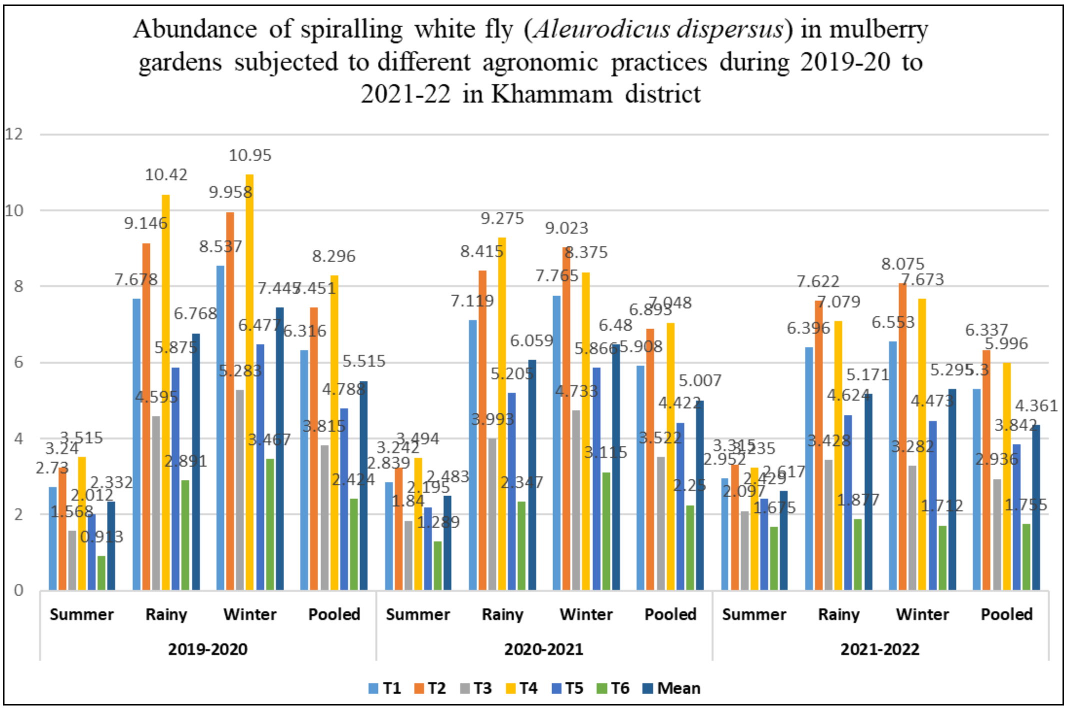

Fig 10: graphical representation of the Abundance of spiralling white fly (*Aleurodicus dispersus)* in mulberry gardens during 2019-20 to 2021-22 in Khammam district

We learned the following as a result of our efforts to record the abundance of numerous insect pests of mulberry under consideration in the current study in relation to their incidence as impacted by various agronomic techniques in the summer, rainy, and winter seasons during 2019–22:

Pests caused by sucking insects: An analysis of the data on the prevalence of sucking insect pests (such as spiralling white fly, jassid, scale insect, mealy bug, and thrips) revealed that, in most treatments, the highest number of these pests was observed in the T4 agronomic package, which included elements like wider spacing, zero tillage, and organic inputs, and the lowest number in the T6 package, which also included zero tillage, wider spacing, organic inputs, and inorganic inputs. Furthermore, in the majority of the treatments, T2 with tillage, closer spacing, and inorganic inputs held the second position for abundance. Generally speaking, the pest abundance followed this order, irrespective of the season and length of monitoring: T4<T2<T1<T5<T3<T6. This was consistent with the incidence of these pests noted in the study's chosen mulberry gardens during the corresponding period [Cardim Ferreira *et al*, 2020] [2]. Stated differently, there has been a direct correlation between the number of these pests and the monitoring period. This means that the agronomic practices used have largely influenced the pest-related parameters, and the influence of any other factors (temperature, relative humidity, rainfall, wind velocity, leaf quality, natural enemies, and so forth) seems to have remained relatively constant over the course of the pest monitoring.

There are several discernible variations in the number of pests found in mulberry gardens in relation to agronomic factors like plant density, irrigation, tillage, nutrient application, pruning/harvesting frequency, and spacing. The impact of agronomic practices on the abundance of mulberry insect pests, including sucking ones, is poorly understood because previous studies conducted by other researchers have only recorded the influence of one or two agronomic practices over a period of three to four years in various agroclimatic regions.

With this in mind, it is evident that the current studies covering the significant agronomic practices that comprised various packages assume enormous significance, particularly when it comes to making decisions ahead of time regarding the kind of pest management strategy to be selected in order to keep the level of economic injury caused by pest abundance below it. The effect of an independent agronomic variable on this pest-related parameter could not be documented because the current experiment was conducted under as-is, at the farmer level. It makes sense that the interplay of the selected agronomic methods in various combinations could be the cause of the abundance of these sucking insect pests. Of course, it was impossible to completely rule out the chance that other elements like temperature, relative humidity, rainfall, wind speed, leaf quality, natural enemies, and so on could interfere. If these elements do interact, they should, nevertheless, continue to be the same and consistent across all of the selected agronomic packages.

Conclusion

Thrips, jassids, scale insects, mealy bugs, and spiraling white flies are among the many sucking insect pests that are prevalent in T4. T6 has the lowest concentration of these pests. In most treatments, T2, which was equipped with tillage, closer spacing, and inorganic inputs, held the second position in terms of abundance. Generally speaking, the quantity of sucking pests was as follows: T4<T2<T1<T5<T3<T6, which corresponded to the pests' incidence regardless of the season or length of monitoring.

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