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# Efficacy of various insecticides and fungicides against thrips and major foliar diseases of garlic

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**Abstract**
A field study was conducted to evaluate the efficacy of various insecticides and fungicides against thrips and major foliar diseases of garlic (*Allium sativum* L.) at the Vegetable Research Station, Junagadh Agricultural University, Gujarat, during the Rabi seasons of 2021-22 to 2023-24. Among eight treatments, fipronil 5% SC @ 1 ml/l + sticker 1 ml/l recorded the lowest thrips population (2.09 thrips/plant) after 48 hours of spray and was statistically on par with the tank mix treatment of metiram 55% + pyraclostrobin 5% WG @ 2 g/l + cyantraniliprole 10.26 OD @ 0.9 ml/l + sticker (2.73 thrips/plant). The latter also exhibited the lowest intensity of purple blotch (7.13%) and stemphylium blight (11.44%) diseases and the highest marketable bulb yield (69.30 q/ha) and net return (₹. 2,59,166/ha). The highest ICBR (1:44.79) was observed with the fipronil-based treatment. These findings suggest that the tank mix treatment offers an effective and economical approach for integrated thrips and major foliar disease management in garlic cultivar GJG-5.

**Keywords:** Garlic, insecticide efficacy, fungicide efficacy, thrips tabaci, purple blotch, stemphylium blight, marketable yield

## Introduction
Garlic (*Allium sativum* L.), a member of the family Alliaceae, is a significant bulb crop globally and ranks second in India after onion. The crop is valued for its medicinal and culinary properties, attributed largely to the organosulfur compound allicin[1]. However, garlic production is often constrained by biotic stresses, notably thrips (*Thrips tabaci* Lindeman) and several foliar diseases such as purple blotch (*Alternaria porri*) and stemphylium blight (*Stemphylium vesicarium*). Thrips infest garlic during the bulb initiation stage, leading to substantial yield losse[2], while purple blotch alone can result in yield reductions of up to 97%[3]. This study investigates the comparative efficacy of insecticides and fungicides under field conditions to provide a cost-effective pest and disease management strategy.

## Materials and Methods
Field experiments were conducted during the Rabi seasons of 2021-22 to 2023-24 at the Vegetable Research Station, Junagadh Agricultural University, using the garlic variety GJG-5. A Randomized Block Design with eight treatments (Table 1) and three replications was followed. Each plot measured 3.0 m × 2.0 m with plant spacing of 15 cm × 10 cm. Sprays were administered at 30, 45, 60, and 75 days after planting. Thrips population counts were recorded pre-treatment and 48 hours post-application. Disease severity was assessed weekly using the Percent Disease Index (PDI). Yield and economic analysis were performed at harvest.

## Results and Discussion
**Thrips Management:** Pre-treatment thrips counts were statistically non-significant (Table 2). All treatments significantly reduced thrips populations post-application compared to the control. Fipronil 5% SC ($T_6$) recorded the lowest population (2.09 thrips/plant), followed by the tank mix treatment ($T_3$) with 2.73 thrips/plant. Control plots ($T_8$) had the highest infestation (20.81 thrips/plant).

**Disease Management:** The lowest purple blotch intensity (3.13% PDI) and Stemphylium blight intensity (11.44% PDI) were recorded in $T_3$, followed by $T_2$ (Table 3). The control recorded the highest disease intensities (33.26% and 44.69%, respectively).

Yield and Economic Returns: $T_3$ resulted in the highest marketable bulb yield (69.30 q/ha) and net returns (₹. 2,59,166/ha) (Table 4). Although T6 recorded the highest ICBR (1:44.79), $T_3$ provided the best combination of thrips and major foliar diseases control with yield and economic viability.

The findings of the present study are corroborated by earlier research. [4] reported that cyantraniliprole 10.6% OD @ 120 g a.i./ha was highly effective against chilli thrips, achieving a 78.03% reduction in population compared to the untreated control. Similarly, [5] demonstrated that fipronil 5% SC @ 1.5 ml/L was the most effective treatment for garlic thrips, resulting in a low population density (5.58 thrips/plant) and the highest recorded bulb yield (166.83 q/ha). [6] also observed significantly reduced incidence of onion thrips with fipronil application.

**Table 1:** Treatment details of experiment

| | | |
|---|---|---|
| **$T_1$** | **:** | Cyantraniliprole 10.26 OD @ 0.9 ml/lit |
| **$T_2$** | **:** | Metiram 55% + Pyraclostrobin 5% WG @ 2 g/lit |
| **$T_3$** | **:** | (Metiram 55% + Pyraclostrobin 5% WG @ 2 g/lit) + (Cyantraniliprole 10.26 OD @ 0.9 ml/lit) - Tank mix |
| **$T_4$** | **:** | Azoxystrobin + Difenoconazole @ 1.25 ml/lit |
| **$T_5$** | **:** | (Azoxystrobin + Difenoconazole @ 1.25 ml/lit) + (Cyantraniliprole 10.26 OD @ 0.9 ml/lit) - Tank mix |
| **$T_6$** | **:** | Fipronil 5% SC @1 ml/lit (Control) |
| **$T_7$** | **:** | Propiconazole 25% EC @1 ml/lit (Control) |
| **$T_8$** | **:** | Control (Water Spray) |
| | | * Sticker 1 ml/lit of water will be added in all treatments |

**Table 2:** Effect of different treatments on thrips population recorded at one day before spray application (pre-count) and 48 hrs. after spray application (post-count) in garlic (GJG-5)

| Sr. No | Treatment | Thrips population (Number / plant) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Count | | | | | Post-Count | | | | |
| | | 1st Spray | 2nd Spray | 3rd Spray | 4th Spray | Pooled | 1st Spray | 2nd Spray | 3rd Spray | 4th Spray | Pooled |
| 1. | $T_1$ | 3.59(13.04)* | 4.02(16.17) | 3.96(15.66) | 4.17(17.38) | 4.01(15.56) | 1.71(2.93) | 1.88(3.62) | 1.87(3.56) | 2.54(6.48) | 2.04(4.15) |
| 2. | $T_2$ | 3.56(12.85) | 4.10(16.85) | 3.86(14.96) | 4.13(17.01) | 3.99(15.42) | 3.85(15.16) | 3.98(16.18) | 3.98(16.10) | 4.27(18.51) | 4.06(16.49) |
| 3. | $T_3$ | 3.55(12.77) | 4.07(16.56) | 4.01(16.12) | 4.06(16.46) | 4.00(15.48) | 1.47(2.17) | 1.56(2.44) | 1.50(2.27) | 1.97(4.05) | 1.65(2.73) |
| 4. | $T_4$ | 3.53(12.58) | 4.07(16.55) | 3.94(15.56) | 4.17(17.42) | 4.00(15.53) | 4.15(17.63) | 4.27(18.59) | 4.25(18.38) | 4.48(20.27) | 4.33(18.72) |
| 5. | $T_5$ | 3.52(12.47) | 4.10(16.86) | 3.99(15.89) | 4.15(17.23) | 4.01(15.61) | 1.86(3.44) | 2.07(4.37) | 1.88(3.54) | 2.53(6.43) | 2.11(4.45) |
| 6. | $T_6$ | 3.51(12.36) | 4.02(16.18) | 3.96(15.69) | 4.17(17.35) | 3.99(15.39) | 1.28(1.68) | 1.31(1.72) | 1.24(1.54) | 1.82(3.42) | 1.45(2.09) |
| 7. | $T_7$ | 3.63(13.29) | 4.08(16.69) | 3.81(14.51) | 4.19(17.58) | 4.00(15.52) | 4.23(18.16) | 4.33(19.04) | 4.25(18.28) | 4.47(20.18) | 4.35(18.91) |
| 8. | $T_8$ | 3.65(13.50) | 4.02(16.14) | 3.98(15.84) | 4.26(18.17) | 4.05(15.91) | 4.45(20.09) | 4.58(21.24) | 4.50(20.46) | 4.62(21.47) | 4.56(20.81) |
| | S.Em.± | 0.28 | 0.38 | 0.41 | 0.37 | 0.18 | 0.24 | 0.20 | 0.20 | 0.22 | 0.11 |
| | C.D. at 5% | NS | NS | NS | NS | NS | 0.72 | 0.61 | 0.62 | 0.66 | 0.30 |
| | C.V.% | 3.83 | 4.00 | 4.53 | 3.66 | 4.03 | 14.25 | 11.57 | 12.06 | 11.29 | 12.27 |
| | Y | | | | | | | | | | |
| | S.Em.± | | | | | 0.13 | | | | | 0.08 |
| | C.D. at 5% | | | | | 0.36 | | | | | 0.22 |
| | YxT | | | | | | | | | | |
| | S.Em.± | | | | | 0.36 | | | | | 0.22 |
| | C.D. at 5% | | | | | NS | | | | | NS |

* Square root transformation used
Pre-count: One day before impose/spray of treatments
Post-count: After 48 hrs. of spray application

**Table 3:** Effect of different treatments on purple blotch and Stemphylium blight diseases in garlic (GJG-5)

| Sr. No. | Treatment | Purple blotch (Percent Disease Index) | | | | Stemphylium blight (Percent Disease Index) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Rabi-2021-22 | Rabi-2022-23 | Rabi-2023-24 | Pooled | Rabi-2021-22 | Rabi-2022-23 | Rabi-2023-24 | Pooled |
| 1. | $T_1$ | 29.71(24.56)** | 30.57(25.86) | 28.75(23.14) | 29.68(24.52) | 34.17(31.55) | 35.33(33.44) | 39.15(39.86) | 36.22 (34.95) |
| 2. | $T_2$ | 16.69(8.25) | 15.61(7.24) | 13.26(5.26) | 15.19(6.91) | 23.24(15.57) | 23.14(15.45) | 26.80(20.32) | 24.39(17.11) |
| 3. | $T_3$ | 13.69(5.60) | 8.27(2.07) | 7.56(1.73) | 9.84(3.13) | 18.79(10.37) | 18.75(10.33) | 21.65(13.61) | 19.73(11.44) |
| 4. | $T_4$ | 23.94(16.46) | 21.62(13.57) | 19.81(11.48) | 21.79(13.84) | 30.40(25.61) | 29.78(24.67) | 32.58(29.00) | 30.92(26.43) |
| 5. | $T_5$ | 19.75(11.42) | 21.49(13.42) | 19.35(10.98) | 20.20(11.94) | 26.97(20.57) | 27.04(20.66) | 31.47(27.26) | 28.49(22.83) |
| 6. | $T_6$ | 30.75(26.14) | 31.80(27.76) | 30.87(26.32) | 31.14(26.74) | 35.64(33.95) | 37.06(36.32) | 42.25(45.21) | 38.32(38.49) |
| 7. | $T_7$ | 29.58(24.36) | 26.47(19.86) | 25.97(19.17) | 27.34(21.13) | 30.74(26.13) | 32.16(28.33) | 37.40(36.89) | 33.43(30.45) |
| 8. | $T_8$ | 35.26(33.33) | 36.14(34.78) | 34.25(31.68) | 35.22(33.26) | 39.73(40.86) | 41.30(43.56) | 44.80(49.64) | 41.94(44.69) |
| | S. Em. ± | 0.92 | 1.42 | 1.03 | 0.66 | 1.20 | 1.26 | 1.53 | 0.77 |
| | C.D. at 5% | 2.79 | 4.31 | 3.12 | 1.88 | 3.64 | 3.83 | 4.63 | 2.20 |
| | C.V.% | 8.49 | 13.61 | 10.98 | 11.19 | 8.13 | 8.22 | 8.08 | 8.19 |
| | Y | | | | | | | | |
| | S. Em. ± | | | | 0.40 | | | | 0.47 |
| | C.D. at 5% | | | | 1.15 | | | | 1.35 |

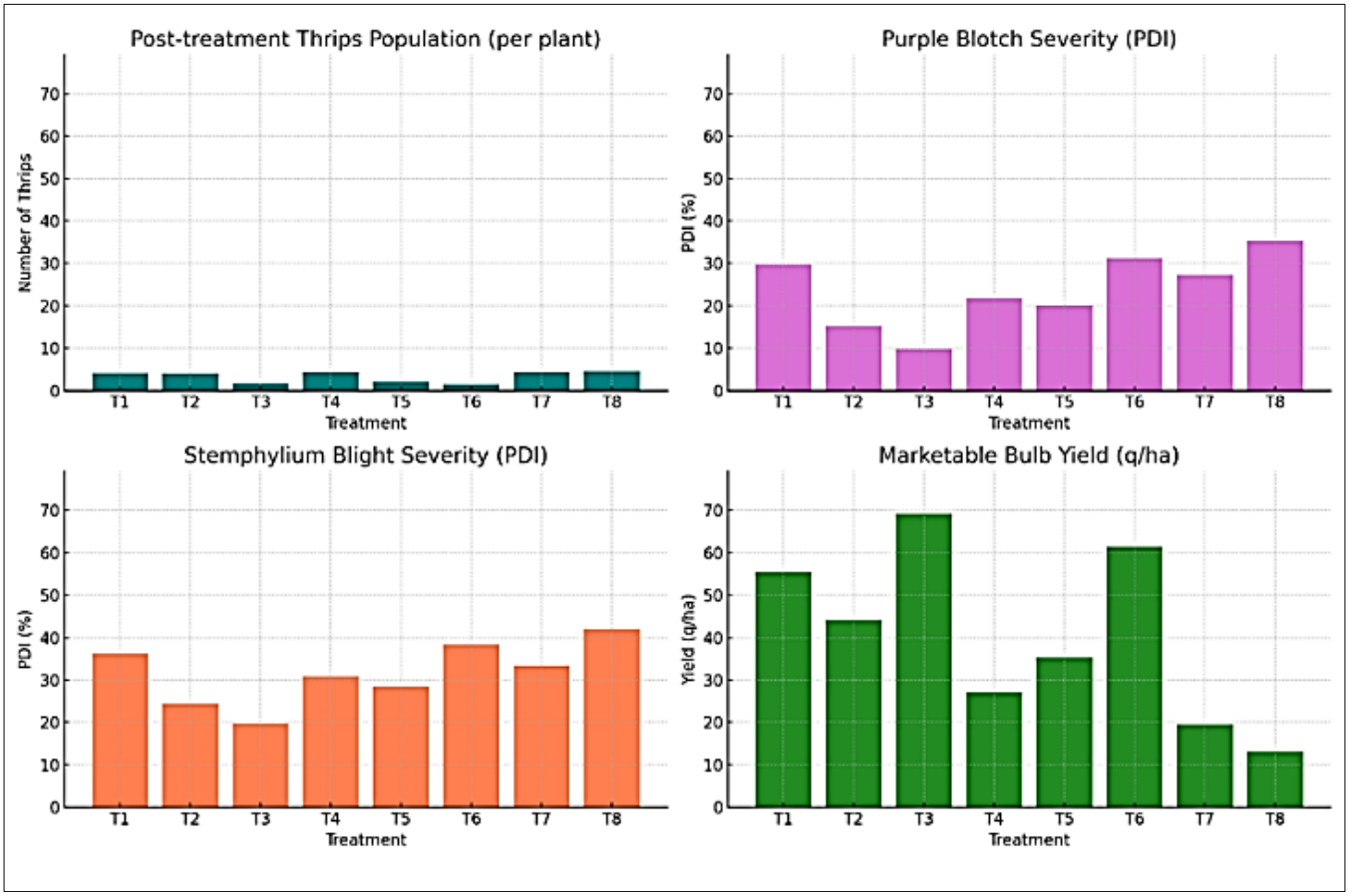
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | YxT | | | | | | | | |
| | S. Em. ± | | | | 1.14 | | | | 1.34 |
| | C.D. at 5% | | | | NS | | | | NS |

**Arc sin transformation used

**Table 4:** Effect of different treatments on marketable bulb yield (q/ha) in garlic (GJG-5) and economics of different treatments against pests and diseases in garlic

| Sr. No. | Treatment | Marketable bulb Yield (q/ha) | | | Pooled | Bulb Yield increased (kg/ha) over control | Additional income (₹/ha) | Cost of treatment with labour charge (₹/ha) | Net realization (₹) | ICBR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rabi-2021-22 | Rabi-2022-23 | Rabi-2023-24 | | | | | | |
| 1. | $T_1$ | 57.50 | 56.67 | 52.22 | 55.46 | 4231 | 211574 | 15124 | 1,96,450 | 1:13.99 |
| 2. | $T_2$ | 45.83 | 44.17 | 42.50 | 44.17 | 3102 | 155093 | 8430 | 1,46,663 | 1:18.40 |
| 3. | $T_3$ | 71.50 | 69.83 | 66.56 | 69.30 | 5615 | 280741 | 21575 | 2,59,166 | 1:13.01 |
| 4. | $T_4$ | 29.17 | 26.67 | 25.33 | 27.06 | 1391 | 69537 | 10839 | 58,698 | 1:6.42 |
| 5. | $T_5$ | 37.50 | 35.83 | 32.50 | 35.28 | 2213 | 110648 | 23983 | 86,665 | 1:4.61 |
| 6. | $T_6$ | 63.33 | 61.67 | 59.17 | 61.39 | 4824 | 241204 | 5385 | 2,35,819 | 1:44.79 |
| 7. | $T_7$ | 20.83 | 19.17 | 18.33 | 19.44 | 630 | 31481 | 5730 | 25,751 | 1:5.49 |
| 8. | $T_8$ | 14.17 | 13.89 | 11.39 | 13.15 | - | - | - | - | - |
| | S. Em. ± | 1.97 | 1.98 | 2.21 | 1.19 | | | | | |
| | C.D. at 5% | 5.99 | 6.02 | 6.69 | 3.39 | | | | | |
| | C.V.% | 8.05 | 8.38 | 9.93 | 8.77 | | | | | |
| | Y | | | | | | | | | |
| | S. Em. ± | | | | 0.73 | | | | | |
| | C.D. at 5% | | | | 2.08 | | | | | |
| | Y x T | | | | | | | | | |
| | S. Em. ± | | | | 2.06 | | | | | |
| | C.D. at 5% | | | | NS | | | | | |

| Note: | 1. | Quantity of spray solution for 1 ha area = 500 liter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cost of inputs : | 1 | Cost of respective pesticide: | | Amount (₹) | | | | | |
| | 1 | Cyantraniliprole 10.60% OD | : | ₹ 8625/lit | 4 | Fipronil 5% SC | : | ₹ 1270/lit. |
| | 2 | Metiram 55% + Pyraclostrobin 5% WG | : | ₹ 1650/kg | 5 | Propiconazole 25% EC | : | ₹ 1500/lit |
| | 3 | Azoxystrobin 18.2% + Difenoconazole 11.4% SC | : | ₹ 3925/lit | 6 | Sticker | : | ₹ 320/lit. |
| | 2 | Labour charge | : | | | | | |
| | A | Foliar spray (spray/ha) | : | ₹ 500/spray | 3 | Price of garlic bulb | : | ₹ 50/kg |



In terms of disease management, [7] reported that difenoconazole achieved the greatest reduction in purple blotch severity (53.84%). Supporting this, [8] found that azoxystrobin 23 EC at 0.1% reduced purple blotch severity to a PDI of 20.74%, while propineb 50 WP at 0.2% followed with a PDI of 25.18%. Furthermore, [9] confirmed the superior field efficacy of difenoconazole (63.29%) and tebuconazole (58.6%) in suppressing purple blotch incidence when compared to untreated plots.

**Phytotoxicity:** No phytotoxic effects were observed in any treatment.

## Conclusion

Four foliar applications of metiram 55% + pyraclostrobin 5% WG @ 20 g/10 L + cyantraniliprole 10.26% OD @ 9 ml/10 L + sticker @ 10 ml/10 L at 30, 45, 60, and 75 days after planting were found to be most effective and economical in managing thrips and major foliar diseases, thereby enhancing garlic yield.

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