**Evaluating Compatibility of Pulse wonder with insecticides and fungicides in greengram**

**Abstract**

A field experiment was conducted in greengram to evaluate the compatibility of pulse wonder with insecticides and fungicides. A total of 9 treatments were tested to study the phytotoxic effects of combination of pulse wonder with insecticides and fungicides. The treatments include, five insecticides (Imidachlorprid @ 0.1% (For sucking pest), Chlorpyriphos @ 0.25% (Foliage feeder), Chlorantriniprole @ 100 ml/acre (For pod borer) and 2 fungicides *viz.,* Mancozeb 0.2% (For fungal disease), Copper oxy chloride 0.25% (For bacterial disease) and their 7 combinations along with untreated control. Also tested in combination with fungicides *viz.,* Mancozeb 0.2% (For fungal disease) and Copper oxy chloride 0.25% (For bacterial disease). Laboratory experiment was also conducted to evaluate the physical compatibility. Physical compatibility test was conducted prior to field study to observe changes in colour, wettability etc., Among 7 combinations of pulse wonder with insecticides and fungicides tested neither foaming nor sedimentation was observed in all 7 combinations of pulse wonder with insecticides and fungicides tested and found to be physically compatible. As the foaming and sedimentation was lower than the prescribed limit (2ml/100ml or 20ml/l), all the combinations of pulse wonder with insecticides and fungicides tested were found to be physically compatible. In the field experiment pulse wonder alone improves the plant growth, flower production, pod number and yield. Whereas pulse wonder along with insecticide and pesticide reduces the pest and disease load but not the flower production and pod number.

Key words: Pulse wonder, insecticide, fungicide, compatibility, greengram

**INTRODUCTION**

Plant growth regulators, pesticides and fungicides are being applied separately for enhancing plant growth and for the control of insect pests and diseases, respectively. This becomes rather costly and also involves more of labour and time in applying. If plant growth regulators and insecticides are applied in association in a single operation it could be cheaper in the view of farmers. Since the pesticides and plant growth regulators are chemically different in nature, their compatibility may pose a problem. Hence it requires thorough investigation before its widespread commercial application. Mixture of two pesticides may produce a greater insecticidal action than the sum of their individual components by exhibiting synergism (Gera, 1973, thus minimising the pesticidal load on the environment. Mixtures may also bring about significant cost efficiency (Hewlett, 1961)

The fungicide (hexaconazole) and insecticide (monocrotophos) were found to have synergistic effect and exerted high efficiency towards pests and disease of grapes (Reddy and Vir, 1991). Padmaja and Kameshwara Rao reported that monocrotophos and carbendazim, carbaryl and mancozeb were highly compatible and recorded higher mortality than their individual insecticidal spray. The combination of herbicides fluchloralin and alachlor with carbendazim, benomyl and carboxin altered their fungicidal action and showed synergistic effect against *Fusarium oxysporum*, *Sclerotium rolfsii*, *A. brassicicola* and *Colletotrichum capsica*. Application of insecticide and growth regulators may surpass the insect population and boost the yield. (Meena et al., 2023). Rajasekhar and Mallapur (2017) reported that carbendazim in combination with insecticide spinetoram (descendant of spinosad) was unable to form sediments or creamy matter which indicates their compatibility with each other. Vidhyadhari et al. (2014) concluded that spinosad was physically compatible with fungicides (viz., copperoxychloride, Metalaxyl MZ) and bactericide (streptocycline). Dileepa and Roopa (2021) proved that carbendazim in combination with commonly used foliar nutrient 19:19:19 was physically compatible with insectides such as thiamethoxam, flubendiamide, profenophos, chlorpyriphos, imidacloprid and chlorantraniliprole as neither foaming nor sedimentation was observed in combined mixture. Hence, the present study was formulated to evaluate the possibility of compatibility of pulse wonder with insecticide and fungicide in blackgram.

**MATERIALS AND METHODS**

**Laboratory experiment**

The compatibility of pulse wonder with insecticides in blackgram, a laboratory study was conducted during 2020-2021 at Agricultural College and Research Institute, Eachangkottai, Thanjavur. The experiment consisted of nine treatments with four replications in Randomized Block Design. The physical compatibility of 7 combinations involving 3 insecticides *viz.,* (Imidachlorprid @ 0.1% (For sucking pest), Chlorpyriphos @ 0.25% (Foliage feeder), Chlorantriniprole @ 100 ml/acre (For pod borer) and 2 fungicides *viz.,* Mancozeb 0.2% (For fungal disease), Copper oxy chloride 0.25% (For bacterial disease) were evaluated with jar compatibility test.

In this test, initially 500 ml of standard hard water was taken with the neutral pH in 1 litre jar to which pulse wonder with insecticide and fungicide were added in the order of Wettable powder (WP) followed by Dry flowables (DF), Flowables (F), Emulsifiable concentrates (EC). The volume of insecticide and fungicide mixture was made up to 1 litre with hard water, agitated by shaking the jar and left undisturbed for 30 minutes. Observations were recorded after 30 and 60 minutes with respect to foaming and sedimentation. Also, pH of insecticides and fungicides alone and in combinations were recorded.

**Field experiment**

A total of 9 treatments were tested to study the phytotoxic effects of combination of pulse wonder with insecticides and fungicides. The treatments include, five insecticides (Imidachlorprid @ 0.1% (For sucking pest), Chlorpyriphos @ 0.25% (Foliage feeder), Chlorantriniprole @ 100 ml/acre (For pod borer) and 2 fungicides *viz.,* Mancozeb 0.2% (For fungal disease), Copper oxy chloride 0.25% (For bacterial disease) and their 7 combinations along with untreated control. For each treatment, 3 litres of tank mix of insecticide and fungicide were prepared as per the dosages and each treatment was replicated thrice. The details of pesticide combinations and their doses are given below:

**Details of the treatments**

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Pulse wonder, Insecticide and fungicide particulars** | **Dosage****(g or****ml/lit.)** |
| T1 | Water | **--** |
| T2 | Pulse wonder alone | 10 g |
| T3 | Pulse wonder @ 2 kg/acre + Imidachlorprid @ 0.1% (For sucking pest) | 10 g+ 1ml |
| T4 | Pulse wonder@ 2 kg/acre + Chlorpyriphos @ 0.25% (Foliage feeder) | 10g+2.5 ml |
| T5 | Pulse wonder @ 2 kg/acre + Chlorantriniprole @ 100 ml/acre (For pod borer) | 10g+1 ml |
| T6 | Pulse wonder @ 2 kg/acre + Mancozeb 0.2% (For fungal disease) | 10 g+2g |
| T7 | Pulse wonder @ 2 kg/acre + Copper oxy chloride 0.25% (For bacterial disease) | 10g+2.5g |
| T8 | Pulse wonder @ 2 kg/acre + Imidachlorprid @ 0.1% + Chlorpyriphos @ 0.25%+ Chlorantriniprole @ 100 ml/acre | 10g+1 ml+2.5 ml+1 ml |
| T9 | Pulse wonder @ 2 kg/acre + Mancozeb 0.2% + Copper oxy chloride 0.25% | 10g+2g+2.5 g |

**Results:**

**Laboratory experiment:**

Physical compatibility test was conducted prior to field study to observe changes in colour, wettability etc., as suggested by Marer (1988). The hydrogen potential (pH) and Ec of the combination products was recorded with digital pH meter after 0.5 and 2 hrs of solution preparation. Storability was also studied by storing the combination product by 10 days under laboratory conditions.

**Table 1: pH of the pulse wonder, insecticides and fungicides sprays fluid alone and their combinations**

|  |  |  |  |
| --- | --- | --- | --- |
| S. No | Treatment particulars | pH | Nature of reaction |
| T1 | Water | 7.0 | Neutral  |
| T2 | Pulse wonder | 5.0 | Acidic |
| T3 | Pulse wonder+Imidachlorprid | 4.1 | Acidic |
| T4 | Pulse wonder + Chlorpyriphos | 4.2 | Acidic |
| T5 | Pulse wonder +Chlorantrinipole | 4.4 | Acidic |
| T6 | Pulse wonder+Mancozeb | 4.6 | Acidic |
| T7 | Pulse wonder+Copper oxy cloride | 4.7 | Acidic |
| T8 | Pulse wonder+Imidachlorprid+ Chlorpyriphos+ Chlorantrinipole | 4.2 | Acidic |
| T9 | Pulse wonder+ Mancozeb+ Copper oxy chloride | 4.8 | Acidic |

The physical compatibility test for foaming, sedimentation, pH and Ec of the mixtures containing the pulse wonder with insecticides and fungicides are presented in table 1. Among 7 combinations of pulse wonder with insecticides and fungicides tested neither foaming nor sedimentation was observed in all 7 combinations of pulse wonder with insecticides and fungicides tested and found to be physically compatible. (Figure 1, 2 and 3). As the foaming and sedimentation was lower than the prescribed limit (2ml/100ml or 20ml/l), all the combinations of pulse wonder with insecticides and fungicides tested were found to be physically compatible.



 **Pulse wonder with imidachlorprid Pulse wonder with copper oxy chloride**

 **(Fig 1) (Fig 2)**



 **Pulse wonder with insecticide and fungicide**

 **(Fig.3)**

Among the insectides and fungicides tested for pH, all the combinations showed acidic pH. According to The University of Arizona reports, compatibility can be influenced by the pH (acidity or alkalinity) of a solution, a neutral solution has a pH of 7. Various insecticides and fungicides are unstable in alkaline solutions (pH > 7), but quite stable in solutions that are slightly acidic (pH of approximately 4.5-5). In the present study the pH ranges from 4.1 to 4.8 for all the seven combinations. Whereas pulse wonder alone has the pH of 5.0.

**Table 2: EC of the pulse wonder, insecticides and fungicides sprays fluid alone and their combinations**

|  |  |  |
| --- | --- | --- |
| S. No | Treatment particulars | EC |
| T1 | Water | 0.187 |
| T2 | Pulse wonder | 12.60 |
| T3 | Pulse wonder+Imidachlorprid | 10.46 |
| T4 | Pulse wonder + Chlorpyriphos | 10.74 |
| T5 | Pulse wonder +Chlorantrinipole | 11.96 |
| T6 | Pulse wonder+Mancozeb | 11.80 |
| T7 | Pulse wonder+Copper oxy cloride | 11.40 |
| T8 | Pulse wonder+Imidachlorprid+ Chlorpyriphos+ Chlorantrinipole | 11.97 |
| T9 | Pulse wonder+ Mancozeb+ Copper oxy chloride | 11.58 |

Table 2 revealed that the combination of pulse wonder with insecticides and pesticides ranges from 10.74 to 11.96. Due to the limited research on growth regulators with insecticide and fungicide combinations limits the ability of compare the results of pH and EC. The tested combinations can be further studied for toxicity against various insect pests, diseases of blackgram crop and other pulse crops.

**Storability:**

The combinations were stored in a container for a one week. All the combinations become turbid in 7 days of storage.

**Field experiment:**

**Effect of combination of pulse wonder with Insecticides**

Effect of imidachlorprid with pulse wonder against greengram whitefly revealed that the pre-treatment population count recorded prior to first spray ranged between 11.19 and 12.89 with non-significant result. One day after the spray 1st, lowest population was observed in T3 (9.05) followed by T8 (9.86), both of them were on par. Pulse wonder 2 kg/acre alone (T2) recorded a population of 11.15, whereas the control had the highest population count of 16.85. At 10 days after treatment T3 (Pulse wonder+Imidachlorprid) recorded lowest population of whitefly (0.75) followed by T8 (5.21) (Pulse wonder+Imidachlorprid+ Chlorpyriphos+ Chlorantrinipole). At 7 DAT, the population of whitefly increased slightly irrespective of the treatments. At this time, maximum population was observed in T1 (15.96), followed by pulse wonder 2 kg/acre alone (15.42). ([Table 3](https://scialert.net/fulltext/?doi=je.2005.52.58#t1)).

Regarding the number of flowers per plant T2 (Pulse wonder alone) recorded highest number of flowers (72.69). No. of pods also recoded high in pulse wonder (T2) alone treated plants (25.25). All other treatments recorded lowest number of flowers and pods as that of control. Combination of pulse wonder with insecticides and fungicides does not increase the number of flowers per plant, number of pods per plant and yield (kg/ha).

**Table 3: Compatibility of pulse wonder with imidachlorprid against population incidence of whitefly (*Bemisia tabaci)* on greengram (Sucking Pest) (Mean whitefly population per 10 plants-days after treatment)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Before Treatment** | **1 DAS** | **3 DAS** | **7 DAS** | **10 DAS** | **Number of flowers/plant** | **Number of pods/plant** | **Yield kg/ha** |
| **T1** | 15.57 | 16.85 | 16.54 | 15.96 | 13.56 | 46.00 | 14.78 | 605 |
| **T2** | 12.24 | 12.27 | 13.21 | 15.42 | 10.25 | 62.69 | 35.25 | 826 |
| **T3** | 11.15 | 9.05 | 2.89 | 3.99 | 0.75 | 50.00 | 37.27 | 773 |
| **T4** | 12.75 | 10.52 | 5.78 | 7.85 | 7.12 | 52.50 | 36.22 | 732 |
| **T5** | 11.54 | 10.75 | 10.77 | 11.54 | 10.75 | 53.25 | 35.90 | 719 |
| **T6** | 11.19 | 12.14 | 12.92 | 13.91 | 11.23 | 52.68 | 35.64 | 789 |
| **T7** | 11.88 | 12.78 | 12.48 | 13.64 | 11.41 | 52.30 | 37.27 | 730 |
| **T8** | 12.89 | 9.86 | 5.46 | 6.21 | 5.00 | 53.27 | 37.90 | 724 |
| **T9** | 12.97 | 12.78 | 12.03 | 14.30 | 12.13 | 51.68 | 17.28 | 736 |
| **CD p=(0.05)** | NS | 0.534 | 1.050 | 1.017 | 0.956 | 1.603 | 0.752 | 10.018 |
| **SEd** | 0.118 | 0.252 | 0.495 | 0.480 | 0.451 | 0.756 | 0.355 | 4.725 |

Compatibility of chlorpyriphos with pulse wonder was studied against leaf defoliators in greengram. Prior to 1st spray, the population count of greengram defoliator ranged between 8.12 and 9.48. Here also, the difference was non-significant. After application of chemical, the population reduced drastically at 1 and 7 DAS, the reduction extended upto the 10th day after application. At that time, control had a population of 9.80, Pulse wonder@ 2 kg/acre + Chlorpyriphos @ 0.25% recorded 3.05 at 10 DAS. (T4) followed by T8 also shower lower pest population (3.53) than control (Table 4). Control had the population of 9.49.

Regarding the number of flowers per plant T2 (Pulse wonder alone) recorded highest number of flowers (68.48). No. of pods also recoded high in pulse wonder (T2) alone treated plants (23.10). All other treatments recorded lowest number of flowers and pods as that of control. Combination of pulse wonder with insecticides and fungicides does not increase the number of flowers per plant, number of pods per plant and yield (kg/ha). All the combinations showed the yield and yield parameters as that of control.

**Table 4: Compatibility of pulse wonder with Chlorpyriphos against Leaf Defoliators**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Before Treatment** | **1 DAS** | **3 DAS** | **7 DAS** | **10 DAS** | **Mean** | **Number of flowers/plant** | **Number of pods/plant** | **Yield kg/ha** |
| **T1** | 8.85 | 9.75 | 9.95 | 9.09 | 9.80 | 9.49 | 35.00 | 15.20 | 615 |
| **T2** | 9.48 | 9.37 | 8.59 | 9.75 | 9.43 | 9.32 | 58.48 | 23.10 | 826 |
| **T3** | 9.14 | 7.02 | 7.26 | 7.05 | 8.88 | 7.87 | 41.00 | 18.20 | 789 |
| **T4** | 8.12 | 2.12 | 2.00 | 1.38 | 3.05 | 3.33 | 43.50 | 18.20 | 736 |
| **T5** | 8.78 | 7.66 | 7.90 | 7.07 | 8.72 | 8.03 | 41.40 | 18.21 | 740 |
| **T6** | 8.56 | 8.45 | 8.67 | 8.84 | 8.50 | 8.60 | 44.10 | 19.00 | 770 |
| **T7** | 8.80 | 8.68 | 8.92 | 8.09 | 8.74 | 8.65 | 40.30 | 17.10 | 775 |
| **T8** | 8.12 | 2.00 | 2.24 | 1.43 | 3.86 | 3.53 | 43.27 | 17.70 | 734 |
| **T9** | 8.74 | 8.61 | 8.87 | 8.08 | 8.67 | 8.59 | 41.78 | 17.10 | 775 |
| **CD****p=(0.05)** | NS | 0.692 | 0.690 | 0.739 | 0.578 | 0.552 | 1.297 | 0.661 | 8.017 |
| **SEd** | 0.965 | 0.326 | 0.324 | 0.348 | 0.272 | 0.260 | 0.621 | 0.311 | 3.782 |

Compatibility of Chlorantriniprole with pulse wonder was studied against pod borers during early stage. During early stage % of infestation was lower in T5 Pulse wonder @ 2 kg/acre + Chlorantriniprole @ 100 ml/acre followed by T8 Pulse wonder @ 2 kg/acre + Imidachlorprid @ 0.1% + Chlorpyriphos @ 0.25%+ Chlorantriniprole @ 100 ml/acre.

As that of previous insecticides yield and yield parameters were recorded lowers in the combination of the products except pulse wonder. (Table 5). T5 recorded higher yield (852.80 kg/ha) followed by pulse wonder alone (842.52 kg/ha).

**Table 5: Compatibility of pulse wonder with Chlorantriniprole against gram pod borer (Helicoverpa armigera ) attacking greengram, at early pod stage and late pod stage (Pod borers)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Healthy pods per plant** | **Infested pods per plant** | **% infestation** | **Number of flowers/plant** | **Yield kg/ha** |
| **T1** | 24.48 | 11.57 | 47.26 | 34.06 | 627.30 |
| **T2** | 34.10 | 11.28 | 33.08 | 59.85 | 842.52 |
| **T3** | 22.89 | 9.12 | 39.84 | 42.02 | 700.78 |
| **T4** | 22.42 | 9.45 | 42.14 | 42.57 | 748.72 |
| **T5** | 21.56 | 6.45 | 29.91 | 42.43 | 852.80 |
| **T6** | 23.52 | 9.46 | 40.22 | 45.18 | 783.40 |
| **T7** | 23.75 | 8.75 | 36.84 | 41.31 | 788.50 |
| **T8** | 23.48 | 7.84 | 33.39 | 44.34 | 746.68 |
| **T9** | 23.95 | 9.85 | 41.12 | 42.82 | 788.50 |
| **CD****p=(0.05)** | 0.923 | 0.621 |  | 1.323 | 9.705 |
| **SEd** | 0.435 | 0.293 |  | 0.624 | 4.578 |

**Effect of combination of pulse wonder with pesticides**

**Table 6: Compatibility of pulse wonder with fungicides in greengram (Mancozeb and Copper oxy chloride)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Cercospora leaf spot** | **Powdery mildew** | **Number of flowers/plant** | **Number of pods/plant** | **Yield kg/ha** |
| **T1** | 57.98 | 55.08 | 35.12 | 17.96 | 645.75 |
| **T2** | 58.35 | 55.43 | 61.22 | 32.26 | 867.30 |
| **T3** | 53.77 | 51.08 | 53.04 | 24.91 | 718.45 |
| **T4** | 57.10 | 54.25 | 55.64 | 25.96 | 767.80 |
| **T5** | 58.12 | 55.21 | 53.46 | 24.92 | 772.00 |
| **T6** | 35.26 | 33.50 | 56.26 | 26.80 | 703.50 |
| **T7** | 56.27 | 53.46 | 52.31 | 25.86 | 718.75 |
| **T8** | 56.00 | 53.20 | 55.40 | 25.44 | 765.70 |
| **T9** | 37.43 | 35.56 | 53.85 | 24.81 | 758.75 |
| **CD****p=(0.05)** | 2.141 | 2.033 | 1.349 | 0.694 | 11.266 |
| **SEd** | 1.009 | 0.959 | 0.636 | 0.327 | 5.314 |

Compatibility of mancozeb and copper oxy chloride with pulse wonder was studied against diseases in greengram.Cercospora and powdery mildew disease were comparatively lower in T6 (35.26; 37.43) and T9  (33.59; 35.56) treated plants respectively. Whereas number of flowers was recorded more in pulse wonder alone treated plants (61.22) and number of pods also recorded more in pulse wonder alone treated plants (32.26).

**Discussion and conclusion**

Application of insecticides and fungicides alone *viz.,* (Imidachlorprid @ 0.1% (For sucking pest), Chlorpyriphos @ 0.25% (Foliage feeder), Chlorantriniprole @ 100 ml/acre (For pod borer) Mancozeb 0.2% (For fungal disease) and Copper oxy chloride 0.25% (For bacterial disease)significantly reduced the whitefly, leaf defoliators, pod borers, cercospora leaf spot and powdery mildew respectively in greengram. When pulse wonder alone was sprayed, it reduced the pest load significantly over control, but the reduction was very meagre. Further, the cumulative effect of insecticides and pulse wonder gave negative results as it has only the insecticidal property not the growth regulating property.

Thus, it is concluded that in vitro experiments combination with pulse wonder all insecticides and fungicides namely imidachlorprid, chlorpyriphos, Chlorantraniliprole, mancozeb and copper oxy chloride were physically compatible because of no foaming, sedimentation and turbidity was noticed. Interestingly, under field condition these combination of pulse wonder with insecticides and fungicides doesn’t work increasing the number of flowers, number of pods and yield where as it is very well worked on pest and disease management.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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