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EFFECTS OF SOME SELECTED AGRO CHEMICALS ON WATER MELON PRODUCTION IN SOUTH EAST NIGERIA

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Abstract

The use of insecticides and fungicides to combat the high incidence of insect pest and diseases has been reported to improve growth and yield of crops in the southeast part of Nigeria. However, continual use of these agrochemicals can directly or indirectly in some situations lead to degradation of soil ecosystem and a wide range of environmental problems. Therefore, optimizing watermelon yield at the lowest possible risk using either or both insecticides and fungicides is recommended; hence it is vital to thoroughly study the impact of insecticide and fungicide use on the growth and yield of watermelon in the study area. The experimental field was laid out in a Randomized Complete Block Design (RCBD), with three (3) blocks and nine (9) treatments constituting various combinations of chloronicotinyl insecticide and carbendazim fungicide viz; T1 = Control (0 L/ha chloronicotinyl + 0kg/ha carbendazim); T2 = 0 L/ha chloronicotinyl + 1kg/ha carbendazim; T3 = 0L/ha chloronicotinyl + 1.5kg/ha carbendazim; T4 = 1L/ha chloronicotinyl + 0kg/ha carbendazim; T5 = 1L/ha chloronicotinyl + 1kg/ha carbendazim; T6 = 1L/ha chloronicotinyl + 1.5kg/ha carbendazim; T7 = 1.5L/ha chloronicotinyl + 0kg/ha carbendazim; T8 = 1.5L/ha chloronicotinyl + 1kg/ha carbendazim; T9 = 1.5L/ha chloronicotinyl + 1.5kg/ha carbendazim. The dimension of the experimental field was 13m by 4m and each plot measured 1m by 1m. Treatment was designated randomly to the plots and sprayed at an interval of one (1) week after germination until final harvest. Data on number of leaves per plant, vine length (cm) and leaf area (cm^2) were taken at 4, 8 and 12 weeks after planting (WAP) while number of fruits per plant, percentage of rotted and marketable fruits per plant as well as marketable fruit yield (t/ha) were taken at the end of the

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Watermelon, Pest control, Agrochemicals, application rates, growth & yield,

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experiment. Results on growth parameters showed significant ($p < 0.05$) lowest mean number of watermelon leaves (8.45 – 19.86), shortest mean length of watermelon vines (13.22 cm – 50.75 cm) and lowest mean number of watermelon vines (2.38 – 5.72) among the chloronicotinyl insecticide and carbendazim fungicide treatments. Also, result on yield parameter showed significant lowest mean number of watermelon fruits (2.88) and yield of marketable fruits (114.00 ton/ha) as well as lowest percentage of marketable fruits 40.59%) and consequently highest percentage of rotted fruits (59.41%) against record means of 3.72 – 4.01 number of watermelon fruits, 198.03 – 231.95 ton/ha marketable watermelon fruit yield, 67.55 – 77.68% of marketable watermelon fruits and 22.32 – 32.45% of rotted fruits in the treated plots. However, a non-significant ($p < 0.05$ decrease in the watermelon yield was observed at chloronicotinyl insecticide rates > 1 L/ha. T6 (77.68%) and consequently a decreasing trend in percentage of rotted fruits of (59.51%) > T2 (32.45%) ≥ T3 (29.45%) ≥ T4 (27.88%) ≥ T7 (27.15%) ≥ T8 (26.05%) ≥ T9 (24.85%) ≥ T5 (22.67%) ≥ T6 (22.32%). The combination of chloronicotinyl and carbendazim also showed significant ($p < 0.05$) treatment effect on the marketable yield of watermelon fruits with an increasing trend in marketable watermelon yield of control (114.00 ton/ha) < T2 (198.03 ton/ha) < T3 (207.80 ton/ha) ≤ T4 (212.99 ton/ha) ≤ T7 (215.45 ton/ha) ≤ T8 (218.95 ton/ha) ≤ T9 (222.43 ton/ha) ≤ T5 (230.71 ton/ha) ≤ T6 (231.95 ton/ha). These imply that use of chloronicotinyl insecticide and carbendazim fungicide was effective in preventing yield losses to fruit diseases but the rate of application should not exceed 1L/ha chloronicotinyl insecticide as a relative non-significant decrease in the fruit of watermelon.

Introduction

Watermelons are nutritious and delicious juicy cucurbits found to possess many medicinal benefits when consumed by man. It is essential to human health as it contains phytochemicals such as lycopene and carotenoid that help prevent heart attacks and certain cancers in humans, potassium, magnesium, phosphorus, calcium, zinc, iron, and cupper which helps in controlling blood pressure and possibly strokes as well as citrulline, an amino acid associated with athletic ability and functioning of the immune system. Also, watermelon has become a cash crop of great importance, therefore mandating the use of yield enhancing factors such as insecticides and fungicides to address the incidence of pests and diseases attributed as one among the major constraints to optimal watermelon production, especially in South east Nigeria.

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The use of insecticides and fungicides to combat the high incidence of insect pest and diseases has been reported to improve growth and yield of crops in the southeast part of Nigeria. However, continual use of these agrochemicals can directly or indirectly in some situations lead to degradation of soil ecosystem and a wide range of environmental problems. Therefore, optimizing watermelon yield at the lowest possible risk using either or both insecticides and fungicides is recommended; hence it is vital to thoroughly study the impact of insecticide and fungicide use on the growth and yield of watermelon in the study area.

Specifically, the objectives of the study were to

- Assess the effect of insecticide application on growth and yield of watermelon in the study area.
- Assess the effect of fungicide application on growth and yield of watermelon in the study area.
- Assess the combination effect of insecticides and fungicides on growth and yield of watermelon in the study area.
- Ascertain the best possible use of insecticides and/or fungicides in watermelon production in the study area.
- Provide recommendations based on findings of the study.

Watermelon is essential to human health as it helps in preventing heart attacks, certain cancers, controlling blood pressure and possibly strokes as well as citrulline, an amino acid associated with athletic ability and functioning of the immune system. Hence, proper crop management practice is essential for optimal yield of watermelon, especially its protection against insect pests and diseases reported to be amongst the predominating constraints affecting its productivity, therefore necessitating the assessment of insecticides and fungicides effect on watermelon production.

The outcome of this study will help in effective management and protection plans for optimal and sustainable watermelon production. It will also be of great importance to students and other researchers who are interested in solving problems on related subject matter.

MATERIALS AND METHODS

The watermelon plant was propagated by seeds. Three watermelon seeds were planted at a spacing of 90cm by 90cm on each experimental plot to produce a total of three stands of watermelon plants per plot, later thinned down to two plant stands at 1 week after germination. Since there were 3 blocks and 9 treatments, there was a total of 27 plots and plant population of 108.

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Experimental design and Research Operation

The experimental field was manually cleared and subsequently laid out in a Randomized Complete Block Design (RCBD), with three (3) blocks and nine (9) treatments constituting various combinations of chloronicotinyl insecticide and carbendazim fungicide viz;

- T1 = Control (0 L/ha chloronicotinyl + 0kg/ha carbendazim)
- T2 = 0 L/ha chloronicotinyl + 1kg/ha carbendazim
- T3 = 0L/ha chloronicotinyl + 1.5kg/ha carbendazim
- T4 = 1L/ha chloronicotinyl + 0kg/ha carbendazim
- T5 = 1L/ha chloronicotinyl + 1kg/ha carbendazim
- T6 = 1L/ha chloronicotinyl + 1.5kg/ha carbendazim
- T7 = 1.5L/ha chloronicotinyl + 0kg/ha carbendazim
- T8 = 1.5L/ha chloronicotinyl + 1kg/ha carbendazim
- T9 = 1.5L/ha chloronicotinyl + 1.5kg/ha carbendazim

The dimension of the experimental field was 13m by 4m and each plot measured 1m by 1m treatment was designated randomly to the plots and sprayed at an interval of one (1) week after germination until final harvest.

Cultural Practices of Watermelon

Each plot was worked into a seedbed before seeds were sown. Weeds were controlled through manual hoeing and subsequently by hand pulling as the watermelon vines spread and covered the plots to thus suppress weed growth at 3-week intervals till maturity and harvest. Poultry manure was applied at the rate of 150 kg/ ha 3 weeks after planting (WAP) to enhance soil fertility and crop yield. Harvesting was carried out when it was observed that fruit tendrils were brown, the fruits became pale yellow at the spot close to the ground, end when the sound of the fruit when thumbed with a knock gives a soft hollow sound instead of metallic ringing sound.

Data Collection

Data on number of leaves per plant, vine length (cm) and leaf area (cm^2) were taken at 4, 8 and 12 weeks after planting (WAP) while number of fruits per plant, percentage of rotted and marketable fruits per plant as well as marketable fruit yield (t/ha) were taken at the end of the experiment.

Data Analysis

Data obtained from field after measurements were subjected to analysis of variance (ANOVA) for Randomized Complete Block Design using Genstat statistical package.

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Mean separation was done using Duncan' s New Multiple Range Test (DNMRT) at 5% level of probability.

RESULTS

The result of the properties of soil used for the study indicated a loamy sand texture with low (SOC<10g/kg) organic carbon, therefore low organic matter content and generally strong (pH<5) acidity compared to the sandy loams textured soil with high organic matter content and optimal pH range of 6.0-6.8 ecological requirement for optimal watermelon production as outlined by Oraegbunam *et al* (2016). This implies that the soil used for the study was not ideal for optimal production of watermelon.

Table 2: Effect of agrochemicals on number of watermelon leaves

Treatment	Number of Leaves		
	4 wap	8 wap	12 wap
T1	8.45^{e}	12.17^{e}	19.86^{d}
T2	14.88^{d}	19.18^{d}	25.57^{c}
T3	15.85^{cd}	20.18^{cd}	26.30^{bc}
T4	16.42^{bcd}	20.76^{bcd}	26.72^{abc}
T5	16.71^{abcd}	21.06^{abcd}	26.93^{abc}
T6	17.61^{abc}	21.97^{abc}	27.57^{abc}
T7	18.66^{ab}	23.01^{ab}	28.29^{ab}
T8	18.79^{a}	23.14^{ab}	28.37^{ab}
T9	18.98^{a}	23.33^{a}	28.50^{a}

Means having the same letter(s) are not significantly different at $p < 0.05$

Result of the experiment showed a significant ($p < 0.05$) effect of chloronicotinyl and carbendazim combinations on the number of watermelon leaves. Control (T1) plots recorded the lowest mean number of watermelon leaves (8.45, 12.17 and 19.86) at the respective aforesaid growth stages of 4,8 and 12 WAP, followed by plots with 0 L/ha chloronicotinyl and 1 kg/ha (T2) carbendazim combinations (14.88, 19.18 and 25.57, 0 L/ha chloronicotinyl and 0 kg/ha (T4) carbendazim combinations (16.42, 20.76 and 26.72), 1 L/ha chloronicotinyl and 1 kg/ha (T5) carbendazim combinations (16.71, 21.06 and 26.93), 1 L/ha chloronicotinyl 1 and 1.5 kg/ha (T6) carbendazim combinations (17.61, 21.97 and 27.57), and then 1.5 L/ha chloronicotinyl and 0 kg/ha (T7) carbendazim combinations (18.66, 23.01 and 28.29), 1.5 L/ha chloronicotinyl and 1 kg/ha (T8) carbendazim combinations (18.79, 23.14 and 28.37) and the highest mean number of watermelon leaves, recorded in plots treated with 1.5 L/ha chloronicotinyl and 1.5 kg/ha (T9) carbendazim combinations (18.98, 23.22 and 28.50). this revealed that the

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use of chloronicotinyl insecticide and carbendazim fungicide, especially when combined promotes production of watermelon leaves.
Table 3 shows the effect of agrochemicals on length of watermelon vines

Table 3: Effect of agrochemicals on length of watermelon vines

Treatment	Vine Length (cm)		
	4 wap	8 wap	12 wap
T1	13.22^{f}	23.49^{f}	50.75^{f}
T2	32.21^{e}	48.04^{e}	75.53^{e}
T3	35.57^{de}	52.03^{de}	78.95^{cd}
T4	37.62^{d}	54.43^{d}	80.95^{cd}
T5	38.67^{cd}	55.64^{cd}	81.95^{cd}
T6	42.00^{bc}	59.46^{bc}	85.03^{bc}
T7	46.00^{ab}	63.97^{ab}	88.55^{ab}
T8	46.50^{a}	64.53^{a}	88.98^{ab}
T9	47.26^{a}	65.38^{a}	89.63^{a}

Means having the same letter(s) are not significantly different at p <0.05 according to DNMRT

The combinations of chloronicotinyl and carbendazim showed significant (p < 0/05) treatment effect on the length of watermelon vines. Control plots recorded the shortest watermelon vines ranging from 13.22cm – 50.75cm relative to the aforesaid growth stages, <T2 plots with vine lengths of 32.21cm – 75.53cm, <T3 plots with 35.57 cm – 78.95 cm <T4 plots with 37.62 cm and 80.95cm <T5 with 38.67cm – 81.95cm, <T6 with 42.00cm – 85.03cm <T7 with 46.00cm – 88.55cm, <T8 with 46.50cm – 88.98cm <T9 with 47.26cm – 89.63cm. This also revealed that the use of chloronicotinyl insecticide and carbendazim fungicide, especially when combined enhanced the length of watermelon vines.

Effect of Agrochemicals on Number of Vines of Watermelon

Table 4: Effect of agrochemicals on number of watermelon vines

Treatment	Number of Vine		
	4 wap	8 wap	12 wap
T1	1.30^{b}	2.10^{b}	3.45^{b}
T2	2.38^{a}	3.52^{a}	4.99^{a}
T3	2.54^{a}	3.71^{a}	5.17^{a}
T4	2.64^{a}	3.83^{a}	5.28^{a}

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T5	2.69[a]	3.88[a]	5.33[a]
T6	2.83[a]	4.06[a]	5.49[a]
T7	3.01[a]	4.26[a]	5.67[a]
T8	3.03[a]	4.28[a]	5.69[a]
T9	3.06[a]	4.32[a]	5.72[a]

Means having the same letter(s) are not significantly different at $p<0.05$ according to DNMRT

Result recorded on number of watermelon vines relative to the aforesaid growth stages of 4, 8 and 12 WAP respectively showed that T2 (2.38, 3.52 and 4.99), T3 (2.54, 3.71 and 5.17), T4 (2.64, 3.83 and 5.28) T5 (2.69, 3.88 and 5.33), T6 (2.83, 4.06 and 5.49), T7 (3.01, 4.26 and 5.67), T8 3.03, 4.28 and 5.69) and T9 (3.06, 4.32 and 5.72) treated plots were significantly at par ($p<0.05$) but higher than number of watermelon vines observed in the control (1.30, 2.10 and 3.45) plots. This also sowed that the use of chloronicotinyl insecticide and carbendazim fungicide, especially when combined enhanced the number of watermelon vines.

Generally, results on the effect of agrochemicals on growth of watermelon show that the use of chloronicotinyl insecticide and carbendazim fungicide, especially when combined is important to promote vegetative growth of watermelon vines. These confirm findings of Awere and Egekwu (2017) that combined use of insecticide and fungicide significantly controls infestation effects of insect pest and diseases on the vegetative growth of watermelon.

Effect of Agrochemicals on Yield of Watermelon

Table 5 shows the effect of agrochemicals on number of fruits per plant, percentage of marketable and rotted fruits and yield of marketable fruits of watermelon.

Table 5: Effect of agrochemicals on watermelon yield

Treatment	Number of Fruits per plant	%Marketable Fruits	%Rotted Fruits	Yieldof Marketable Fruits (ton/ha)
T1	2.88[b]	40.59[e]	59.41[a]	114.00[f]
T2	3.72[a]	67.55[d]	32.45[b]	198.03[e]
T3	3.82[a]	70.55[cd]	29.45[bc]	207.80[d]
T4	3.88[a]	72.12[bc]	27.88[cd]	212.99[cd]
T5	4.13[a]	77.33[a]	22.67[e]	230.71[a]
T6	4.15[a]	77.68[a]	22.32[e]	231.95[a]

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T7	3.92^{a}	72.85^{bc}	27.15^{cd}	215.45^{bcd}
T8	3.96^{a}	73.89^{abc}	26.05^{cde}	218.95^{bc}
T9	4.01^{a}	74.91^{ab}	24.85^{de}	222.43^{bc}

Means having the same letter(s) are not significantly different at $p<0.05$ according to DNMRT

Result recorded on number of watermelon fruits plant showed that T2 (3.72), T3 (3.82), T4 (3.88), T5 (4.13),n T6 (4.15), T7 (3.92), T8 (3.96) and T9 (4.01) treated plots were significantly at par ($p < 0.05$) but higher than number of watermelon fruits per plants in the control (2.88) plots. This also showed that the use of chloronicotinyl insecticide and carbendazim fungicide, especially when combined enhanced the production of watermelon fruits.

The combinations of chloronicotinyl and carbendazim showed significant ($p < 0.05$) treatment effect on the percentage of marketable and rotted fruits. The result showed a significant ($p < 0.05$) trend of increasing percentage of marketable fruits of control (40.59%) < T2 (67.55%) ≤ T3 (70.55%) ≤T4 (72.12%) ≤ T7 (72.85%) ≤ T8 (73.89%) ≤ T9 (74.91%) ≤ T5 (77.33%) Type equation here.

Summary, Conclusion and Recommendations

Summary

The effect of agrochemicals on watermelon, *Citrullus lanatus* production in Nekede, Imo State Southeast Nigeria was assessed using a Randomized complete block Design (RCBD), with three (3) blocks and nine (9) treatments constituting various combinations of chloronicotinyl insecticide and carbendazim fungicide and obtained data were subjected to analysis of variance and separated at $p < 0.05$ according to Duncan's New Multiple Range Test (DNMRT). Results on growth parameters showed significant ($p < 0.05$) lowest mean number of watermelon leaves (8.45 – 19.86), shortest mean length of watermelon vines (13.22 cm – 50.75 cm) and lowest mean number of watermelon vines (2.38 – 5.72) among the chloronicotinyl insecticide and carbendazim fungicide treatments. Also, result on yield parameter showed significant lowest mean number of watermelon fruits (2.88) and yield of marketable fruits (114.00 ton/ha) as well as lowest percentage of marketable fruits 40.59%) and consequently highest percentage of rotted fruits (59.41%) against record means of 3.72 – 4.01 number of watermelon fruits, 198.03 – 231.95 ton/ha marketable watermelon fruit yield, 67.55 – 77.68% of marketable watermelon fruits and 22.32 – 32.45% of rotted fruits in the treated plots. However, a non-significant ($p < 0.05$ decrease in the watermelon yield was observed at chloronicotinyl insecticide rates > 1 L/ha.

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T6 (77.68%) and consequently a decreasing trend in percentage of rotted fruits of (59.51%) > T2 (32.45%) ≥ T3 (29.45%) ≥ T4 (27.88%) ≥ T7 (27.15%) ≥ T8 (26.05%) ≥ T9 (24.85%) ≥ T5 (22.67%) ≥ T6 (22.32%).

The combination of chloronicotinyl and carbendazim also showed significant ($p < 0.05$) treatment effect on the marketable yield of watermelon fruits with an increasing trend in marketable watermelon yield of control (114.00 ton/ha) < T2 (198.03 ton/ha) < T3 (207.80 ton/ha) ≤ T4 (212.99 ton/ha) ≤ T7 (215.45 ton/ha) ≤ T8 (218.95 ton/ha) ≤ T9 (222.43 ton/ha) ≤ T5 (230.71 ton/ha) ≤ T6 (231.95 ton/ha).

These imply that use of chloronicotinyl insecticide and carbendazim fungicide was effective in preventing yield losses to fruit diseases but the rate of application should not exceed 1L/ha chloronicotinyl insecticide as a relative non-significant decrease in the fruit of watermelon. This was in line with findings of Awere and Egekwu, (2017) who reported maximum fruit yield at 1 L/ha of chloronicotinyl insecticide but decreased non significantly at rates > 1 L/ha of chloronicotinyl insecticide.

Conclusion

Results indicated that the combined use of chloronicotinyl and carbendazim agrochemicals generally affected the number of leaves and vines, vine length, number of fruits, percentage of marketable and rotted fruits and marketable yield of watermelon and was therefore effective in preventing yield losses to foliar and fruit diseases especially when the rate of chloronicotinyl insecticide does not exceed 1 L/ha.

Recommendation

Findings of this study indicated that the combined used of chloronicotinyl and carbendazim agrochemicals will effectively prevent foliar and fruit diseases, hence both vegetative and fruit yield of watermelon, especially when the rate of chloronicotinyl insecticide does not exceed 1 L/ha. Therefore, the combination of 1 L/ha of chloronicotinyl insecticide and carbendazim fungicide is recommended for optimal prevention of insect pests and diseases infestation on watermelon.

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