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INCREASE YIELD AND REDUCE ANTHRACNOSE DISEASE OF TARO BY FOUR PESTICIDES

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Abstract

The field study was carried out from April to October 2022 to evaluate the effects of four pesticides on the management of anthracnose on taro caused by Colletotrichum sp. caused in Lap Vo district, Dong Thap province. The experiment was arranged with 5 treatments and 4 replications. Experimental results show that in four experimental pesticides, Penncozeb 75DF has the highest preventive effect from 69.8% to 88.4% against anthracnose on the taro. The next effective was Aliette 800WG with a preventive effect from 64.0% to 75.8%. The effective of Anvil 5SC had a preventive effect from 56.1% to 69.0 and Tracomix 760WP had the lowest disease prevention effect from 39.8% to 54.4%. Penncozeb 75DF had a high percentage of whole tubers (80.0%), a low percentage of damaged bulbs (20.0%) leading to the highest yield (22.8 tons/ha) because of effective control of anthracnose. The treatment with Aliette 800WG had the percentage of whole tubers (78.2%), the percentage of damaged tubers (21.8%) and yield (21.2 tons/ha). Treatment of Anvil 5SC had the ratio of good tubers (77.4%), the rate of rot tubers (22.6%) and the yield (20.5 tons /ha).Tracomix 760WP treated with the lowest percent of good tubers (74.6%), the maximum percent of rot tubers (25.4%) and the minimum productivity (19.1 tons / ha) compared to the pesticide treated treatments but still higher than the yield in the control treatment (15.0 tons/ ha).

Key words: Anthracnose Disease, Penncozeb 75DF, Taro, Aliette 800WG, Anvil 5SC

1. INTRODUCTION

Taro [Colocasia esculenta (L.) Schott], which has been a popular and preferred crop around the world thank to its color, flavor and nutritional value, was one of the food crops with a long history of cultivation about 9000 years ago. It was first domesticated in India and Southeast Asia, then continues to grow around the world (Zhou et al., 2018). Taro, which is the 4th most important plant after potato, sweet potato and cassava, plays an important role in food security of smallholder farmers. The annual taro growing area is about 15,000 ha (Nguyen Thi Ngoc Hue et al., 2010). However, the taro yield has yearly decreased by a number of diseases, in which anthracnose is the most serious consequence (Hou et al., 2020). Some common diseases of taro have been recorded such as mosaic virus disease, green wilt caused by Ralstonia solanacearum, seedling death caused by Fusarium spp. particularly, the most interest is anthracnose caused by Colletotrichum spp. because the disease can cause serious damage to the yield and quality of taro tubers (Pearson et al., 1999). Nowaday. Anthracnose disease that mainly cause by Colletotrichum fungus is one of the important diseases on many crops in the Mekong Delta such as chili, cucumber, tomato, taro... Therefore, using pesticides is a popular technique that has been studied in the world to manage plant diseases against anthracnose caused by the fungus Colletotrichum lagenarium (Ramanatha et al., 2009). The profit of taro is often higher than many times that of rice. However, one of the biggest

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obstacles in taro cultivation is anthracnose, which caused by Colletotrichum sp. This is one of the dangerous pests that seriously affect the yield and quality of taro tubers. That is one of the main reasons for the decrease in cultivation areas, yield and quality of this crop in Lap Vo district. Finding out about effective prevention and control measures of some pesticides in anthracnose control is necessary and urgent to help farmers restore and develop the taro cultivation area in Lap Vo district, in order to contribute to the diversification of crops towards a diversified and sustainable agriculture (Nguyen Thi Ngoc Hue et al., 2010)..

2. MATERIALS AND METHODS

Experimental materials

The experimental soil was an alluvial soil in My An Hung A commune, Lap Vo district, Dong Thap province. The crop soil is cleaned of weeds, plowed, dried and divided plots efore planting. Experimental equipment: Spray bottle (16 liters), medicine bucket, mark, ruler, and camera. Local taro variety had a growth period of 150 days. Sowing date: April 1, 2022, planting interval: 70 x 100 cm (14,286 plants/ha). Total fertilizer (kg/ha) consisted of 600 kg Urea, 100 kg DAP, 250 kg KCl and NPK fertilizer 16-16-8 was 700 kg per ha.

Experimental method

The experiment was arranged in a completely randomized block design (RCBD) with five treatments and four replications. The total area of each treatment was 50 m2 (including the walkway 2.5 m x 20 m). The experimental treatments included: Treatment 1 (NT1): Anvil 5 SC, spray dose of 20ml/ container of 16 liters; Treatment 2 (NT2): Aliette 800WG, spray dose of 40g/container of 16 liters; Treatmentl 3 (NT3): Tracomix 760WP, spray dose of 30g/ container of 16 liters; Treatment 4 (NT4): Penncozeb 75DF, spray dose of 50g/ container of 16 liters; Treatment 5 (NT5-Control) without spraying. How to treat drugs: Spray evenly on leaves (sheaths), diseased plants, avoid handling during rain and early morning dew (spray when the disease appears).

Table 1: Pesticides and dosages in treatments

No.	Name	Composition	Dosage (container of 16 liters)
NT1	Anvil 5 SC	Hexaconazole (85%)	20ml
NT2	Aliette 800WG	Fosetyl Aluminium (95%)	40g
NT3	Tracomix 760WP	Propineb 700g/kg + Cymoxanil 60g/kg	30g
NT4	Penncozeb 75DF	Mancozeb (75%)	50g
NT5	Control	Without spraying pesticides	

Tracking criteria: Rate of disease (%) is the number of sick leaves/ total number of examined leaves x 100. Disease index (%) = (∑[(N1 x 1) + (N3 x 3)... + (Nn x n)]/ N x K) x 100. N1: Number of sick leaves at level 1; Nn: Number of sick leaves at level n; N: Total number of leaves; K: The highest disease level of the standard. The classification of leaf anthracnose on taro plants from level 0 to level 9 according to the Plant Protection

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Association is as follows: Grade 0: No damaged leaves; Grade 1: <1% of area Damaged leaves; Disease grade 3: 1-5% of affected leaf area; Disease grade 5: > 5-25% of damaged leaf area; Grade 7 disease: > 25-50 % affected leaf area; Disease grade 9: > 50% affected leaf area. Disease rate (%) and disease index (%): Investigation period included 1 day before spraying, 7 and 14 days after spraying pesticides.

The potency of the experimental pesticides was calculated according to the formula (Joseph et al., 2016). Q (%) = [1- (Ta x Cb)/ (Tb x Ca)] x 100. Q: potency (%), Ta: Disease index in the experimental batch after spraying drug, Tb: Disease index in the experimental batch before spraying pesticides, Ca: Disease index in the control group after spraying pesticides. Cb: Disease index in the control group before spraying pesticides. Yield components: Ratio of whole tubers (%) = (a/b) x 100 including: (a) number of good tubers; (b) total number of tubers. Number of plants/ha: Total number of taro plants planted per hectare. Average weight of one tuber (Ptb): Take 50 bulbs and weigh to get the average weight of 1 tuber (g). Number of tubers/plant: the number of tubers per plant. Theoretical yield (t/ha) = (Number of plants/ha x number of tubers/plant x Ptb)/100 x 1000. Actual yield (t/ha): the yield per experimental plot after weighing (Counted by t/ha).

Data Analysis:

Data on monitoring indicators were collected and statistically processed using Excel, STATGRAPHICS XVIII software. The F-test (ANOVA) and the DNCAN test were used to compare the differences between treatments.

3. RESULTS AND DISCUSSION

Effects of pesticide on anthracnose of the taro in the winter-spring crop of 2022

Use of suitably cutivated method such as good seeds, applying fertilizers in a balanced manner, an appropriately planting density and pesticide to prevent the disease in time is a necessary and indispensable measure. In addition, finding suitable pesticide to supplement and alternate use to avoid resistance to the currently used pesticide and proved ineffective. Therefore, we conducted an effective test against anthracnose on taro of some chemical drugs in order to determine the most appropriate pesticide that can both eliminate anthracnose disease and bring suitable economic benefits to farmers.

Table 2. Effect of pesticides on the anthracnose rate on taro

Treatment	before spraying	Disease rate of anthracnose (%)					
		1st spray		2nd spray		3rd spray	
		7 DAP*	14 DAP	7 DAP	14 DAP	7 DAP	14 DAP
Anvil 5 SC (NT1)	8.75b	5.63bc	4.38bc	8.75b	5.42c	5.71c	4.64bc
Aliette 800WG(NT2)	9.38ab	5.00c	3.75c	7.50bc	4.16d	5.36cd	3.57c
Tracomix 760WP(NT3)	8.75b	6.88b	5.00b	9.16ab	6.66b	7.14b	6.42b
Penncozeb 75DF(NT4)	9.38ab	5.63bc	3.13d	7.08c	3.33e	3.21d	2.50d
Control (NT5)	10.0a	11.3a	11.9a	12.9a	12.9a	9.28a	9.64a
Ftest	*	*	*	*	*	*	*
CV (%)	21.9	12.5	14.9	13.1	12.8	11.8	13.1

*DAP: Days after praying; (*): significantly different at leve 5%.

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The results of Table 2 showed there was significant difference amonong the treatments at level 5%. At 7 days after spraying the 1st spray, the percentage of anthracnose rate ranged from 8.75 to 10.0% and significant difference at level 5% before the 1st spray. The maximum anthracnose rate was 10.0 at NT5 (control) and minimum rate of treatment NT1 and NT3 (8.75%). Among the experimental pesticides, Aliette 800WG of treatment NT2 had the lowest rate of 5.00%, followed by Penncozeb 75DF (NT4) and Anvil 5 SC (NT1) with 5.63%, Tracomix 760WP had the lowest rate (6.88%) after 7 days after spraying in the 1st spray. There was a tendency to decrease the anthracnose rates, which varied from 3.13 to 5.00% in 14 DAP of the 1st spray. In the 7 and 14 DAP of the 2nd spray, the maximum anthracnose rates of 7 DAP and 14 DAP were 12.9% in control, conversely, the minimum rates of anthracnose observed at NT4 of 7DAP and 14 DAP (7.08 and 3.33 %, respectively). Similarly, in the 3rd spray, the Penncozeb 75DF was the lowest disease rate of 7DAP (3.21%) and 14 DAP (2.50%), and treatment of NT5 (control) had the highest anthracnose rate of 7 DAP (9.28%) and 14DAP (9.64%) in the 3rd spray. The following lower anthracnose rates were treatments of NT1, NT2 and NT3 compared to control. Frequent synthetic chemical sprays on cowpea and other crops to stem fungal diseases 2-3 WAI has also been reported (COPR 1981). Edema and Adipala (1994) and Oparaeke (2007) reported that weekly sprays with mancozeb or extracts of P. guineense on cowpea 2 WAP until flowering and podding significantly controlled brown rust (Uromyces vignae) and bruchids in the crop. In another study, Bretag (2008) found that for effective control of anthracnose disease of lentil, the fungicide Bravo 500 (50% Chlorothalonil) should be applied prior to onset of the disease and repeated a fortnight later while Awurum et al. (2016) reported that maintaining biweekly sprays of botanicals on onion and Amaranthus significantly checked the initiation, development, and spread of wet rot and anthracnose disease in the crops which corroborates the recommended control period at 4 WAP than 6 WAP for anthracnose of cowpea.

Disease index indicates the percentage of diseased leaf area, which depends on disease lesions on leaves. The higher disease index, the more diseased leaf area, leading to poor plant growth due to loss of photosynthetic ability. Through the results of Table 3 was found that there was no difference among the treatments at level 5%. In time 7 days after the first spray, the disease appeared on all experimental treatments, but there was insignificantly different among treatments before and after spraying of the 1st spray. However, there were significant differences among treatments at level 5% in the 2nd and 3rd spray. In the 7 and 14 DAP of the 2nd spray, the highest disease index of 7 DAP and 14 DAP were 3.66 and 3.94%, respectively in treatment 5 (control). On the contrary, the lowest disease index showed at NT4 of 7DAP and 14 DAP (1.34 and 0.37 %, respectively. Similarly, in the 3rd spray, the Penncozeb 75DF (NT4) had the lowest disease index of 7DAP (0.36%) and 14 DAP (0.28%), and treatment of NT5 (control) had the highest disease index of 7 DAP (2.86%) and 14DAP (2.94%) in the 3rd spray. The following lower anthracnose index were treatments of NT1, NT2 and NT3 compared to control. From above results, it showed that the treatments sprayed with pesticides, which had remarkably different at level 5%. In the pesticide spray treatments, there were disease

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spots, mostly due to the influence of weather and unbalanced fertilizer. Speciallly, Penncozeb 75DF had the best preventive effect, followed by Aliette 800WG, Anvil 5 SC, and Tracomix 760WP with the lowest effectiveness compared to control. Oparaeke, (2007) found that the effectiveness of Penncozeb 75DF improved significantly on the anthracnose index. The combination of bicarbonate or carbonate with Penncozeb 75DF was synergistic. The objective of the present study was to examine the possibility of using Penncozeb 75DF and the yeast Candida oleophila to reduce anthracnose incidence and severity of stored and shipped papaya fruit.

Table 3: Effect of pesticides on the anthracnose disease index on taro

Treatment	Before spraying	Disease index of anthracnose (%)					
		1st spray		2nd spray		3rd spray	
		7 DAP*	14 DAP	7 DAP	14 DAP	7 DAP	14 DAP
Anvil 5 SC (NT1)	1.25	0.76	0.49	1.89bc	0.97bc	0.87bc	0.67
Aliette 800WG(NT2)	1.32	0.69	0.42	1.57c	0.46c	0.75bc	0.52cd
Tracomix 760WP(NT3)	1.18	1.04	0.56	2.13b	1.57b	1.11b	1.03b
Penncozeb 75DF(NT4)	1.39	0.63	0.35	1.34d	0.37d	0.36c	0.28d
Control (NT5)	1.46	1.60	1.81	3.66a	3.94a	2.86a	2.94a
Ftest	ns	ns	ns	*	*	*	*
CV (%)	14.7	13,5	13.2	18.5	7.17	15.6	13.0

*DAP: Days after praying ;(ns): insignificantly different at leve 5%;(*): significantly different at leve 5%.

Penncozeb 75DF had the highest preventive effect on taro anthracnose from 69.8% to 88.4%; Aliette 800WG had a preventive effect from 64.0% to 75.8%; Anvil 5SC has a preventive effect from 56.1% to 69.0% and Tracomix 760WP had the lowest disease prevention effect from 39.8 to 54.4% (Table 4). In general, four experimental pesticides could be used to prevent anthracnose on taro. However, farmers should choose Penncozeb 75DF for prevention and anthracnose treatment, because it had a good effect on preventing anthracnose in order to reduce the cost of spraying Plant Protection products and bring the best effect.

Table 4: Prevention effect of four pesticides on the anthracnose on taro

Treatment	Concentration (kg /ha)	Prevention effect (%)		
		1st spray	2nd spray	3rd spray
Anvil 5 SC	0.6	57.2	56.1	69.0
Aliette 800WG	1.2	64.0	70.5	75.8
Tracomix 760WP	0.9	42.0	39.8	54.4
Penncozeb 75DF	1.5	69.8	76.4	88,4

Note: Prevention effect of four pesticides was calculated based on the disease index (%)

The results of Table 5 showed that Penncozeb 75DF obtained the best effective control of anthracnose, which resulted in the highest percentage of whole tubers (80.0%), reduced the lowest percentage of rotten tubers (20.0%) leading to the maximum yield (22.8 t/ha). Spraying with Aliette 800WG had the percentage of good tubers (78.2%), the

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percentage of rotten tubers (21.8%) and the actual yield (21.2 t/ha). The treatment of Anvil 5SC had the percentage of good tubers (77.4%), the percentage of rotten tubers (22.6%), and the actual yield (20.5 t/ha). Spraying with Tracomix 760WP had the low percentage of good tubers was (74.6%), the percentage of rotten tubers was high (25.4%), which resulted in the low yield (19.1 t/ha) but still higher than that of the control (15.0 t/ha). In the control treatment (without pesticide spray), the disease rate and disease index were high, limiting the photosynthetic ability and transporting nutrients to the taro tubers, so the highest percentage of rotten tubers was 29.6%, the lowest rate of good tubers (70.4%) lead to the lowest yield (15.0 t/ha). Thereby, these reseach results found out that anthracnose had affected the rate of taro tubers. if we want to increase productivity and efficiency on the same area, we should choose suitable pesticides to prevent each growth stage.

Table 4: Effect of four pesticides on the yield components of taro

Treatments	weight of one tube (g)	Rate of Good tubers (%)	Rate of rotten Tubers (%)	Theoretical yield (t/ha)	Actual yield (t/ha)
Anvil 5 SC (NT1)	185bc	77.4bc	22.6c	26.5ab	20.5ab
Aliette 800WG(NT2)	190b	78.2ab	21.8d	27.1ab	21.2ab
Tracomix 760WP(NT3)	179c	74.6cd	25.4b	25.6bc	19.1bc
Penncozeb 75DF(NT4)	200a	80.0a	20.0e	28.5a	22.8a
Control (NT5)	149d	70.4d	29.6a	21.3cd	15.0cd
Ftest	*	*	*	*	*
CV (%)	12.9	10.5	11.1	11.2	11.9

(ns): insignificantly different at level 5%;(*): significantly different at level 5%.

The promotion in the yield and yield components of the crop recorded in this study is thought to be brought about by two mechanisms-reduction of the growth and spread of the fungal pathogen causing the anthracnose disease and stimulating or priming of the crop immunity to resist further attacks by the disease-causing organism (Enyiukwu et al. 2016). Pesticides derived from Gliocladium virens showed strong antibiosis against Alternaria helianthi evidenced by bursting of the hyphae of the pathogen and inhibiting its cellulose, cutinase and chitinase activities (Anitha and Murugesan 2012). Phytochemicals gleaned from Dennetia tripetala, Azadirachta indica and Spondias mombin improved the yield and quality of the treated crops by stemming the fungal attacks on the plants. These plant materials contain phenols and phenolic acids. Phenols are aromatic alcohols, which are constituents of various ranges of pesticides (Okwu and Njoku 2009; Enyiukwu and Awurum 2013a). Spraying pesticides early enough was thought to have supplied phenols to, or improved the production of infection-fighting phenolics or radicals such as hydrogen peroxide in the taro through re-inforcing the structural components of its walls thereby reducing the advancement and damage due to fungal pathogens resulting in improved yield and quality of produce (Awurum et al. 20165). Therefore the ability of the phytochemicals used in this study to improve the yield and quality of the treated cowpea may be due to these protective mechanisms developed by the host due to the phytochemicals from the test plant materials.

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4. CONCLUSION

The study result showed effect of Penncozeb 75DF, which was the highest preventive effect for anthracnose on taro compared to three other pesticides and control, could prevent the occurrence and development of the disease. The following high preventive effects of anthracnose on taro were Aliette 800WG, Anvil 5SC. Tracomix 760WP had the lowest effectiveness of anthracnose prevention of taro compared with three other pesticides but higher than that of control. Actual yield of Penncozeb 75DF spray treatment obtained the maximum output, which was 34.2% higher than that of control.

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