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Pest and Diseases Control Using Synthetic and Botanical Pesticides on Several Wheat Varieties

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*⁾ Corresponding author: E-mail: amran.muis@yahoo.co.id The research was carried out to find out the effect of wheat varieties and types of pesticide to control the naturally occurred pests and diseases. The research was designed in a split plot experiment with three replications. The main plot was 3 botanical pesticides (eugenol+eugenol acetate+caryophillene, azadirachtin, citronellal) and 1 synthetic pesticide (dimehypo 550 g/l) and 1 control (distilled water). The subplot was 4 wheat varieties (Guri 1, Guri 3, Guri 4, and Guri 6). Twice application of botanical pesticides was carried out at 30 and 60 days after planting (DAP). Results showed that in both vegetative and generative stage, two main pests were found, namely: Atherigona sp. and stem borer Sesamia inferens. Shoot fly incidence occured before the application of pesticide treatments. The percentage of incidence ranged from 10.33% at Guri 1 to 35.00% at Guri 6. No interaction among the applied treatments was observed on the average percentage of stem borer incidence on both growth stages. The visibly found disease was leaf blotch disease caused by Bipolaris sorokiniana. All evaluated varieties were very susceptible to leaf blotch. The harvestable grain yield was very low due to the attacks of shoot fly, stem borer and also high incidence of leaf blotch.

ABSTRACT

INTRODUCTION

Wheat like many other major food crop commodities. possess considerable major constraints of pest and diseases that could hamper optimum grain yield production. Various types of pests and diseases in wheat have been reported through substantial researches, such as: several species of aphids, stink bugs, armyworms, cutworms, stem borer, cereal leaf beetles, thrips, Hessian flies, wheat stem maggot, sawfly, white grubs, wireworms, snails, slugs, grasshoppers, crickets, and mites (ARC, 2013; Prescott et al., 1986). In Pakistan, it was reported that although many types of pests attacked wheat, severe damage caused by aphids could significantly cause yield loss up to 35-40% if it damages directly. These aphids also indirectly functions as a virus vector for a major disease, which consequently could cause yield loss up to 20-80% (Khan, Khan, Afzal, & Iqbal, 2012). BISI (2013) also reported that shoot fly attacks on young plants of rice, corn and wheat. Bhowmik & Rudra (2017) assessed the infestation of pink stem borer and varietal performances. of wheat under different tillage condition. They found that the infestation was comparatively more at maturity under zero tillage condition. The result of research conducted by the Indonesian Cereals Research Institute in 2013 and 2014 noted that the species of pests that damage wheat crops in Malino, Gowa Regency and in Rumbia Jeneponto Regency were Mythimna separata, Sesamia inferens and S. calamistis. Furthermore, there were also several major diseases of that have been reported, such as rust, Karnal Bunt, and Helminthosporium leaf blight (Prescott et al., 1986). Helminthosporium leaf blight disease is a serious disease in wheat especially in hot regions of South Asia (Sharma & Duveiller, 2003). Grain yield loss due to spot blotch ranged from 25% to 43% (Sharma and Duveiller, 2006).

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Johnson & Townsend (2009) suggest that under suitable environmental conditions, certain types of pests can cause a significant loss of wheat yield. Some of them damage directly on leaves, stems and panicles or other plant parts. Fortunately, the possibility of severe attacks can be reduced by applying good cultivation practices, such as using resistant varieties.

Overcoming pests and diseases constraints, proper control needs to be carried out, namely integrated pest management (IPM) that applied all possible techniques of by planting, physical, mechanical, biological, and chemical methods. In order to avoid the negative impact of inorganic pesticides to the environment, current alternative is by applying botanical pesticides.

El-Wakeil (2013) stated that botanical pesticides have been in use for a long time for pest control. The compounds offer many environmental advantages. However, their uses during the 20th century have been rather marginal compared with other bio-control methods of pests and pathogens. Islam et al. (2013) studied on the use of tobacco extracts, neem extracts, and karonja in controlling yellow stem borer, *Scirpophaga incertulas* in rice field and they found that neem extracts reduced dead heart and white head incidences by 38.38% and 58.08% respectively.

Nurmansyah (2014) reported that citronellal botanical pesticides were effective in suppressing *Helopeltis antonii* on cocoa. Neem leaf extract (azadirachtin) was effective in controlling fly on chilies at larval and imago stages (Juanda & Jayadi, 2015).

Ndakidemi, Mtei, & Ndakidemi (2016) mentioned that botanical and synthetic pesticides generate acute toxicity and sub-lethal effects on beneficial insects that are responsible for natural pest control and pollination. Furthermore, the negative effects posed by botanicals however, are of more concern as this might limit the effectiveness of biological pest control strategies. Promising results have been obtained using compounds derived from aromatic plants for the control of agricultural pests. Such compounds of botanical origin can be highly effective, with multiple mechanisms of action, while at the same time having low toxicity towards nontarget organisms or not destroy beneficial natural enemies and provide residue-free food and safe environment (Campos et al., 2019; Hikal, Baeshen, & Said-Al Ahl, 2017).

This research objectives was to find out the effect of type of pesticides to control naturally occurred pests and diseases in several wheat varieties.

MATERIALS AND METHODS

This research was conducted in Malakaji Village, Tompo Bulu District, Gowa Regency from May to September 2018. The experiment was arranged using split-plot design with three replications. The main plot was three types of botanical pesticides (Mitol 20EC = a.i. eugenol and sitral, Siori SPO 20 EC = a.i. Azadiractin (1,0 – 1,5%), nimbinen, gedunin, Nano = a.i. citronellal), and one synthetic pesticide (Suryatan Plus 550SL = dimehypo 550 g/l) and one control treatment (distilled water). While the subplot was 4 wheat varieties namely: Guri 1, Guri 3, Guri 4, and Guri 6. All botanical pesticides used were formulated botanical pesticide produced by Indonesian Spice and Medicinal Crops Research Institute (ISMCRI).

The botanical pesticides were applied twice during the plant life cycle, first at 30 DAP and secondly at 60 DAP. In each application, the concentration of botanical pesticides was arranged at 5 ml/l aquadest. Suryatan Plus (contact and stomach poison insecticides in the form of a solution in water) was also applied at the same time with botanical pesticide application with the dosage of 2 ml/l distilled water.

The plot area for each treatment combination was 2 x 3 m. Each variety was planted in 9 rows per plot with with the distance of 25 cm between row and 1 m between the plot. Inoculation/ investment of pests and diseases occurs naturally. Fertilizer application was carried using 200 kg/ha administering Urea and 300 kg compound fertilizer (Phonska). Observation of the types of pests and damage was done directly in the field.

The parameters observed were types of pests and diseases in the vegetative and generative stage, percentage of pest and disease incidences and yields.

Damage due to shoot fly and stem borer was measured by counting plants infected in 10 tiller clumps samples randomly in each plot. Shoot fly incidence was obtained by counting the number of tiller clumps of plants attacked by the respected insect. Percentage of affected plants was calculated using the formula:

P = Percentage of attacked plants;

a = Number of attacked plants;

b = Total number of plants

Stem borer attacks were obtained by counting the number of tillers attacked per clump. The percentage of stem borer attacks was calculated using the formula:

$P = \frac{a}{b} x$	100%	 	 	 	 	2)
Where:						

P = Percentage of attacked tiller;

a = Number of tiller attacked;

b = Total number of tiller observed.

In addition to observing pests, types of diseases found was also observed. Disease scoring was done based on the scale presented in Table 1.

Table 1. Scale of leaf blight disease on wheat

Scale	Leaf infected area
1	No incidence
2	< 1% of incidence
3	1-5% of incidence
4	6-10% of incidence
5	11-15% of incidence
6	16-25% of incidence
7	26-50% of incidence
8	51-75% of incidence
9	76-100% of incidence

The disease scale reading results were transformed to the severirty formula calculated based on Townsend and Heüberger (1943) equation in Agrios (2005) as follows:

P = Percentage of disease incidence;

n = number of samples in each category;

v = value in each category;

v – value ili each category,

Z = highest scale value; N = total sample size.

RESULTS AND DISCUSSION

Young plants and the subsequent growth were generally vigorous in all varieties, but at the beginning of growth (2 weeks after the planting) the attacks of shoot fly were initially observed in all varieties. Typical symptoms of shoot fly (*Atherigona* sp.) was the damage on the inner tissue of young plants stem. As plants grow, leaves turned into yellow and dry, tiller formation decreases, and finally the plant died (Fig. 1). Plant was uprooted and the roots became dry and at the base of the stem developed a hole. Shoot fly attacks the plants at the early growth stage until 1 month. The change of leaf color from green into yellowish was the initial symptoms of shoot fly attack. Severe attacks may cause rotting at the base of stem and make the plant wilting and died.

The incidence of shoot fly attacks during vegetative stage occured before application of botanical pesticides treatments (30 DAP). The shoot fly that attacked the wheat crop probably came from rice and corn plants around the study site. The percentage of shoot fly incidence on Guri 1 ranged 6.0-13.7%, 8.3-18.3% on Guri 3; 15.0-33.3% on Guri 4 and 10.0-60.0% on Guri 6. The results of statistical analysis of the percentage of seedling flies infestation showed significant differences among Guri 1, Guri 3, Guri 4, and Guri 6 (Table 2).

From observations of pests incidence in the vegetative stage of the plant, the incidence of stem borer attacks were also found with varied in each variety and pesticide treatments (Table 3). The species of stem borer found was Sesamia inferens (Fig. 2). Shrivastava, Verma, & Singh (2014) suggested that S. inferens was commonly found in land in rice-wheat intercropping. These pest generally attack wheat plants in the young plant stage. Stem borer larvae damaged the stem tissue of wheat plants, and the symptoms of incidence in vegetative stage are yellowing of leaves which eventually dry and die. While the symptoms of incidence in the generative stage was on the panicles which turned into white and empty (Fig. 3). Gupta, Kumar, & Mishra (2015) stated that S. inferens larvae bores the stem of young plants and kills the central shoot causing dead heart, whereas in the generative stage causes panicles of whitebrown vaginal discharge cause symptoms of "white ears".

The results of statistical analysis on the average percentage of incidence in the vegetative stage showed that there was no interaction between varieties and botanical pesticides treatments. Variations were observed among botanical pesticides treatment, yet negligible among the tested varieties.

Varieties			Pesticides			Average
	Nano	Mitol 20EC	Siori SPO 20EC	Suryatan	Control	Average
GURI 1	10.0	8.7	13.3	6.0	13.7	10.33 a
GURI 3	10.7	8.3	7.0	18.3	13.3	11.53 a
GURI 4	15.0	21.7	33.3	30.0	30.0	26.00 b
GURI 6	30.0	10.0	40.0	35.0	60.0	35.00 b
Average	16.4	12.2	23.2	22.3	29.3	

Table 2. Average of shoot fly incidence at 21 DAP

Remarks: Means with the same letter are not significantly different at 5% level based on LSD test.

Table 3. Average percentage	on the incidence of stem bor	er in vegetative stage (45 DAP)
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Variation	Pesticides						
varieties	Nano	Mitol 20EC	Siori SPO 20EC	Suryatan Plus 550 SL	Control	Average	
GURI 1	17.0	20.9	20.6	17.2	25.9	20.3	
GURI 3	20.9	17.5	19.6	22.8	36.2	23.4	
GURI 4	18.3	19.0	16.8	18.2	36.4	21.7	
GURI 6	19.4	21.0	20.8	24.3	29.1	22.9	
Average	18.9a	19.6a	19.5a	20.6a	31.9b		
CV/ a: 20.86%	CV/ b: 24 25%						

CV a: 29.86%; CV b: 24.25%

Remarks: Means with the same letter are not significantly different at 5% level based on LSD test.





Fig. 1. Symptoms of shoot fly incidence on plant

Table 3 shows that the lowest percentage of stem borer incidence was found in the treatment of Nano botanical pesticide with the value of 18.9%, while the highest was found in the control treatment with value of 31.9%.

In vegetative stage, there were two insect pests found in studied wheat, i.e. *Atherigona* sp. and *S. inferens*, while, in the generative stage only *S. inferens* was found. The symptoms of *S. inferens* was presented Fig. 1 and Fig. 3.

The results of statistical analysis on the percentage of stem borer incidences in the generative stage showed that there was no interaction between varieties and treatment of botanical pesticides treatments. Percentage of stem borer was found varied among botanical pesticides treatments but less variation was observed among the tested wheat varieties (Table 4).

Overall, the results of this study indicated that the influence of botanical pesticides in suppressing the stem borer incidence is still low. These conditions was predicted to have relation with the frequency of botanical pesticide applications. According to Indiati (2017), the application of botanical pesticides were subjected to be more frequent since the toxic nature is easily degraded. The study conducted by Nurmansyah (2014) on the effect of application intervals and the time of spraying citronellal botanical pesticides on *Helopeltis antonii* on cocoa plants concluded that the once a week application was more effective than every two and three weeks. Furthermore, El-Wakeil (2013) also stated several factors appear to limit the success of botanicals, most notably regulatory barriers and the availability of competing products (newer synthetics and fermentation products) that are cost effective and relatively safe compared with their predecessors.

The most prominent disease that attacked during the growth of the studied wheat plants was spot blotch caused by pathogenic fungus *Bipolaris sorokiniana* (Fig. 4). Varietal differences were clearly shown on the percentage of spot blotch attacks. Guri 6 was considered more sensitive to spot blotch disease than the other three tested varieties (Table 5). Nevertheless, the overall the percentage disease attacks in all varieties were considered very high, ranging from 42.8% to 66.8%.

Table 5 also showed that percentage of disease incidence ranged from 50.7-57.4% and no significant difference among pesticide treatments. These conditions inferred that active ingredients of all pesticides were less effective to supress spot blotch development. These findings was not in line with the study of Bahadar, Munir, & Asad (2016) that 10% eucalyptus plant extract can inhibit the development of pathogenic *B. sorokiniana* up to 97%.



Fig. 2. a) Larvae and b) adult S. inferens



Fig. 3. Symptoms of stem borer in generative stage

Table 4	Average	percentage o	of stem bore	er incidence	in generative	stage ((75 DAP)
	Average	percentage c			in generative	Slaye (1

Variation	Pesticides						
varieties	Nano	Mitol 20EC	Siori SPO 20EC	Suryatan Plus 550 SL	Control	Average	
GURI 1	23.5	20.2	18.2	21.2	26.2	21.9	
GURI 3	21.5	18.5	17.1	19.7	27.0	20.8	
GURI 4	25.3	16.8	15.5	21.9	31.9	22.3	
GURI 6	23.2	18.5	23.1	22.1	25.3	22.4	
Average	23.4b	18.5a	18.5a	21.2ab	27.6c		
CV a: 25.29%	: CV b: 21.6	2%					

Remarks: Means with the same letter are not significantly different at 5% level based on LSD test.

Table 5. Average of	percentage of sp	pot blotch disease	incidence in g	generative sta	age
0					<u> </u>

Variation	Pesticides						
varieties	Nano	Mitol 20EC	Siori SPO 20EC	Suryatan Plus 550 SL	Control	Average	
GURI 1	55.6	46.7	49.6	54.1	58.5	52.9 a	
GURI 3	45.2	37.8	43.7	39.3	48.1	42.8 a	
GURI 4	52.6	49.6	49.6	49.6	54.1	51.1 a	
GURI 6	65.9	68.9	64.4	65.9	68.9	66.8 b	
Average	54.8	50.7	51.9	52.2	57.4		
CV a: 43.07%:	CV b: 26.88	3%					

Remarks: Means with the same letter are not significantly different at 5% level based on LSD test.





Fig. 4. Symptoms of spot blotch, Bipolaris sorokiniana (a) and its conidial form (b)

Furtherly, Bahadar, Munir, & Asad (2016) stated that, *B. sorokiniana* is an important pathogen in wheat plants since this pathogen can attacks almot all plant organs with various symptoms (blight sprouts, root rot, spot blotch/leaf blight, and black spots on seeds). Another study reported by Naz, Nosheen, Yasmin, Bano, & Keyani (2018) stated that the application of *Jacaranda mimosifolia* leaf extract added with low-dose fungicide (*J. mimosifolia* + mefenoxam 0.1%) has the opportunity to control leaf blight in wheat.

The recorded pest and diseases during the plant life cycle were shoot fly, *S. inferens* and spot blotch.

CONCLUSION

Wheat variety Guri 1 and Guri 3 have less incidence of shoot fly than to Guri 4 and Guri 6. Comparable to synthetic pesticide dimehypo 550 g/l, the application of eugenol + eugenol acetate + caryophyllene and azadirachtin were more effective in controlling wheat stem borer than citronellal. Variety Guri 3 treated by synthetic pesticide had the least stem borer incidence. All four varieties were susceptible to spot blotch disease with the incidence range between 42.8% to 66.8%. Guri 3 has the less spot blotch infection than other tested varieties. No pesticide was effective in controlling spot blotch disease. The pest and disease attacks, i.e. shoot fly, stem borer, and spot blotch disease.

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