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Fluopyram 250G/L+Trifloxystrobin 250 G/L, Increases Fungicides Options for the Control of Angular Leaf Spot and Rust of Beans in Tanzania

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ABSTRACT

A mixture of Fluopyram 250G/L+ Trifloxystrobin 250G/Lwas tested for the control of angular leaf spot and rust of beans in Tanzania using the bean variety Jessica, commonly cultivated but susceptible to particular diseases. The data for Fluopyram 250G/L+ Trifloxystrobin 250G/Lwere compared to Bayleton 25WP (Triadimefon 250g/Kg) at its recommended dose rate. All fields plots sprayed with Fluopyram 250G/L+ Trifloxystrobin 250G/Lat the rates of 0.15L/ha, 0.2L/ha and 0.3L/ha gave significantly lower ($P<0.05$) number of infected leaves, pods and increased ($P<0.05$) bean yield by up to 52%. Throughout the experimental periods all Fluopyram 250G/L+ Trifloxystrobin 250G/Ltreatments were comparable to Bayleton 25WP. Spraying Fluopyram 250G/L+ Trifloxystrobin 250G/Lat the dose rates of 0.2L/ha and 0.3L/ha showed higher significant difference to untreated control as compared to the dose rate of 0.15L/ha. The use of Fluopyram 250G/L+ Trifloxystrobin 250G/Lfor the control of angular leaf spot and bean rust could be potential to provide farmers with more choice hence avoid pathogen resistances and resurgence. We provide data valuable for the consideration of this combination for registration purposes in Tanzania.

Keywords: *Fluopyram, Trifloxystrobin, angular leaf spot, bean rust, Triadimefon*

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is an important legume in the world mainly grown as an affordable and cheap source of protein among majority of sub-Saharan African families (Dzudie *et al*. 2002). According to FAO- STAT estimate for the year 2006, world beans production was 1235 kg ha−1 while that of Africa was 799 kg ha−1. The average beans yield per annum in many African countries is always lower than that of the world. Lack of improved varieties associated with edaphic and biotic factors has been attributed as one of the basic sources of beans production constraints (Grahamand *et al*.1997).

In Tanzania, common beans (*Phaseolus vulgaris* L.) are widely cultivated mainly by small-scale farmers and are in most cases intercropped with maize, millet, banana and coffee. They are best suited in cool, high rainfall highland areas of the country (BACAS, 2000). The average common bean yield is 741 kg ha−1 which is low and does not meet the increasing demand. There was a large increase in bean production between 1960 when 80,000 Mt were produced, and 1980 when production reached 282,000 tonnes (FAO, 2008). Production of common beans in Tanzania has been declining and is currently at a range of 200 to 700kg of dry seeds per hectare, among the production constraints being Angular leaf spot and bean rust diseases caused by *Phaeoisariopsis griseola* and Uromyces *appendiculatus* respectively.

Angular leaf spot (ALS) is among the most destructive diseases of common beans. The disease is ranked second among biotic and abiotic factors that constrain bean production in Africa (Aggarwal *et al*. 2003). *P. griseola* causes lesions on almost all upper parts of bean plant including leaves, pods,

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branches, and petioles that result in severe defoliation, but symptoms are most recognizable on leaves (Bergamin Filho *et al*. 1997). Lesions on leaves usually appear as brown spots with a tan or silvery centre that are initially confined to tissue between major veins, which gives it an angular appearance (Stenglein *et al*. 2003; Miklas *et al*. 2006). The symptoms of *U. appendiculatus* are chlorotic, raised pustules on the surface of leaves, pods and petioles, without causing severe defoliation (Allen, 1995; Allen and Lenne, 1998).

Recently, angular leaf spot disease incidence and severity have increased in many areas where beans are cultivated (Stenglein *et al*. 2003). According to Stenglein *et al*. (2003), infected seeds, plant debris, volunteer plants and off-season crops have been identified as important sources of *P. griseola* inoculum. In the absence of the living host, the pathogen has been reported to survive for up to 19 months on host plant debris. The use of resistant varieties as disease management practices is regarded as the most practical approach to disease control at the farm level (Wagara *et al.* 2003). The greatest set-back to this strategy is the high pathogenic variability occurring in *P. griseola* that renders bean varieties that are resistant in one location or year to be susceptible in another. Therefore, chemical control remains the effective approach for management of angular leaf spot and rust on common beans to date (Sindhan and Bose, 1979).

Several fungicides have proven effective, such as benomyl, captafol, captan, carbendazim, thiophanate-methyl, triforine, zineb and ziram. Correa *et al*. (1989). Multiple sprays of the systemic fungicide increased yields by 33-41% (Correa *et al*. (1989). However, continuous application of same fungicides for several seasons may result into building up of pathogen resistances to the fungicides. This remains the reason to introduce more fungicides with new molecules or different mode of actions for sustainable and effective control of angular leaf spot and other related foliar diseases of common beans. In this study, we evaluated the performance of *Fluopyram 250G/L+Trifloxystrobin 250G/L*by determining the efficacy and effective application dose rates for the control of angular leaf spot and bean rust among other fungal foliar diseases of common beans in Tanzania. We also investigate the positive and negative effects of Fluopyram 250G/Land Trifloxystrobin 250G/Lto the crop particularly phytotoxic effects.

MATERIALS & METHODS

Experiments for *Fluopyram 250G/L+Trifloxystrobin 250G/L*were carried at Madiira area, Moivaro in Arusha region and Lyamungu area, Kilimanjaro region using the bean variety Jessica, commonly cultivated but susceptible to angular leaf spot, bean rust and other related diseases affecting beans in Tanzania. The efficacy of *Fluopyram 250G/L+ Trifloxystrobin 250G/L* was compared to Bayleton 25WP which was considered in this trial as standard fungicide.

The fields used for the experiments were cultivated and divided into four equal blocks in a randomized complete block design with four replicates. Each plot was planted with 20 bean plants at spacing of 75 cm between rows and 50 cm within rows making a plot of $32m^2$. The fungicides were sprayed at the different plots using knapsack sprayers with Fluopyram 250G/L+ Trifloxystrobin sprayed at three application dose rates of 0.15L/ha, 0.2L/ha and 0.3L/ha was applied separately to three plots while Bayleton 25WP (Triadimefon 250g/Kg) was applied separately at its recommended rates of 0.5 Kg/ha on the fourth plot and the fifth plot was left as unsprayed control. The initial sets of experiments were carried out from February 2014 to May 2014; the second set was carried out from October 2014 to February 2014; and the third set was conducted from February 2015 to May 2015. The first spray in each experimental field was applied immediately after the appearance of the first symptoms of targeted diseases on beans plants. The sprays that followed after were applied at 14 days interval. Four sprays were applied during the long and short rains. The incidence and severity

of angular leaf spot, bean rust and other related diseases on leaves and pods were assessed by using 0 – 5 scale, where 0 = no serious symptoms and 5 = all leaves and pods are infected .The assessment were conducted after every seven days and one day before spraying the fungicides. Bean pods were counted, harvested and then weighed to determine their yields per hectare. The non-experimental variables including weeding and fertilizer application were maintained at the recommended levels to ensure that these variables could not introduce errors to the results.

The data collected from the different experiments was subjected to analysis of Variance (ANOVA) using Genstat statistics software (14th edition, VSN International Ltd). When significant difference obtained between treatments, the means comparison was done using Fischer's protected test, to find least significance differences between treatments.

RESULTS & DISCUSSION

All fields plots of beans in Madiira area, Moivaro and Lyamungu which were sprayed with Fluopyram 250g/L+Trifloxystrobin 250G/Lat three dose rates of 0.15L/ha, 0.2L/ha and 0.3L/ha and Bayleton 25WP at the dose rate of 0.5 Kg/ha, gave significantly lower ($P<0.05$) number of infected leaves and pods than plots that were not sprayed (Table. 1). Throughout the experimental periods all Fluopyram 250g/L+Trifloxystrobin 250G/Ltreatments were comparable to Bayleton 25WP for the control of angular leaf spot, bean rust and other related diseases affecting beans. However, The spraying of Fluopyram 250G/L+Trifloxystrobin 250G/Lat the dose rates of 0.2L/ha and 0.3L/ha showed higher significant different to untreated control as compared to the dose rate of 0.15L/ha. This implies that the dose rates of 0.2L/ha and 0.3L/ha are the important dose rates for the control of angular leaf spot, bean rust and other related diseases affecting beans. However, the number of infected leaves and pods in the 0.2L/ha treated plots is lower than those in the untreated plots in most of the cases throughout trial seasons (Table. 1). The mean number of uninfected bean pods and yield of beans obtained in the field plots that were treated with different rates of fungicides were significantly higher ($P<0.05$) than those produced in the unsprayed plots throughout the trial.

Table1. *The effect of Fluopyram 250G/L+ Trifloxystrobin 250G/Ltreatments on the control of angular leaf spot and bean rust of common beans grown at Moivaro area-Arusha Region (Three cropping seasons)*

	Angular leaf spot (ALS)				**Bean rust (BR)**	
Treatments	Mean number of leaves	Mean Number of infected leaves	Mean number of Pods	Mean Number of diseased Pods	Mean number of leaves	Mean Number of infected leaves
Fluopyram 250G/L+Trifloxystrobin (0.15L/ha)	44	4.67b	22.92	7.98b	44	2.4ab
Fluopyram 250G/L+Trifloxystrobin (0.2L/ha)	39	3.42b	24.49	2.11c	39	1.9bc
Fluopyram 250G/L+Trifloxystrobin (0.3L/ha)	42	0.91c	21.32	1.89c	42	1.4c
Bayleton 25WP (0.5kg /ha)	48	1.08c	22.21	1.66c	48	1.6c
Untreated control	37	18.01a	23.94	17.99a	37	2.9a
Mean	**42**	**5.62**	**22.98**	**6.33**	**42**	**2.1**
$L.S.D_{0.05}$	**NS**	**1.3**	**NS**	**4.02**	**NS**	**0.6**

The number of diseased pods in the unsprayed plots was higher ($P<0.05$) than those in the sprayed plots. There were no significant differences ($P<0.05$) in beans yield between Fluopyram 250G/L+ Trifloxystrobin 250G/Lapplication rates of 0.2L/ha and 0.3L/ha and 0.5 Kg/ha dose rate of Bayleton 25WP (Figure. 2). Application of Fluopyram 250G/L+Trifloxystrobin 250G/Lon bean field

significantly (P<0.05) bean yield by up to 52 percent in which the increase was significantly higher at the dose rate of 0.3L/ha (Figure. 3). During trial periods other fungal diseases like *Anthracnose* and *Alternaria* leaf spot were hardly observed in all field plots spraying with either Fluopyram 250G/L+Trifloxystrobin 250G/Lnor Bayleton 25WP but were observed in the untreated plots in some occasions. Moreover, application of Fluopyram 250G/L+ Trifloxystrobin 250G/Lat all rates did not cause any negative effects on the beans in the field. These findings confirm the effective performance of Fluopyram 250G/L+Trifloxystrobin 250G/Lusing the dose rates of 0.2L/ha and 0.3L/ha for the control of angular leaf spot, bean rust and other related diseases affecting beans. However, the application of Fluopyram 250G/L+Trifloxystrobin 250G/Lat the rate of 0.15L/ha should be when the incidence of the diseases is low.

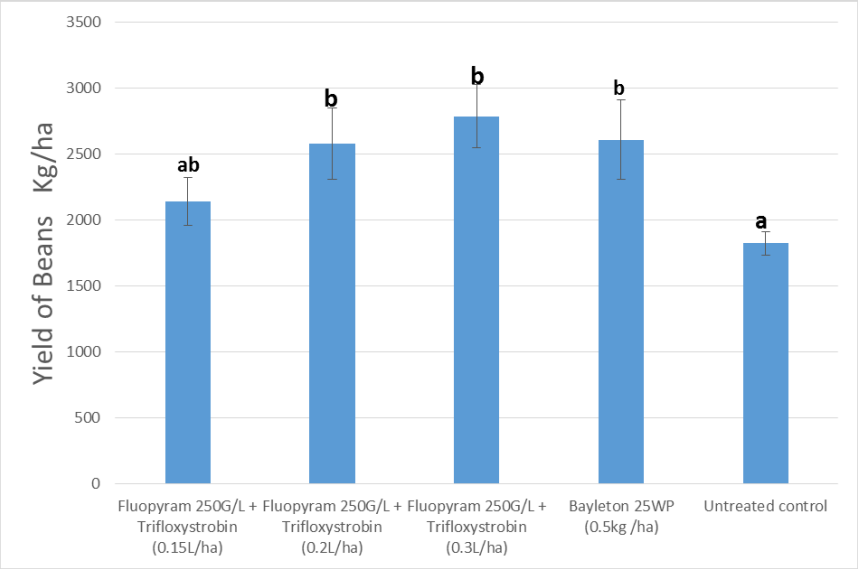

Figure2. *The effect of Fluopyram 250G/L+ Trifloxystrobin 250G/Ltreatments on the control of angular leaf spot and bean rust of common beans grown at Moivaro area-Arusha Region (Three cropping seasons); Yield of beans as per different treatments. NS=Not Significant, means followed by the same letter do not differ significantly (P≤0.05) according to Fischer's Protected Test. Data are means of four replicates*

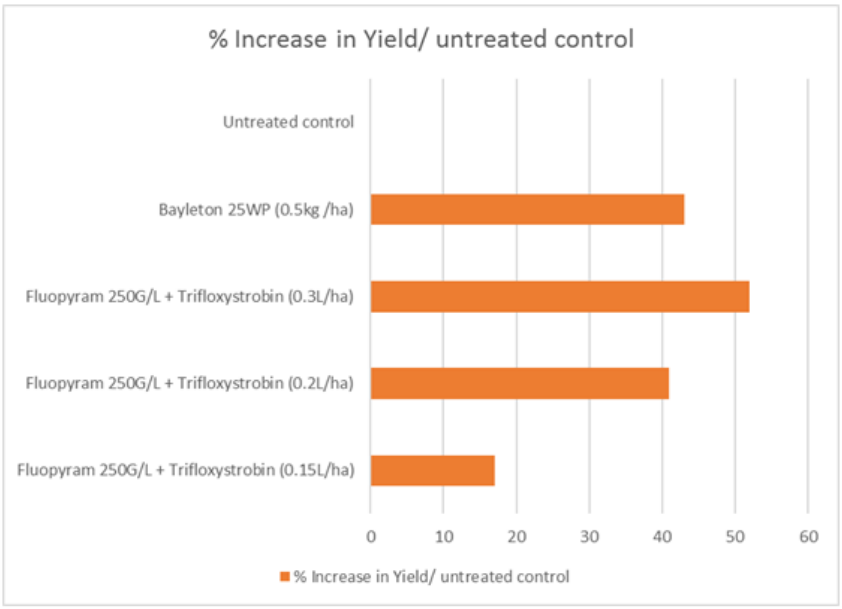

Figure3. *The effect of Fluopyram 250G/L+ Trifloxystrobin 250G/Ltreatments on the control of angular leaf spot and bean rust of common beans grown at Moivaro area-Arusha Region (Three cropping seasons); Percentage increase in yield of beans as per different treatments relative to untreated control*

Several fungicides have proven effective, such as benomyl, captafol, captan, carbendazim, thiophanate-methyl, triforine, zineb and ziram. Correa et al. (1989) for the control of angular leaf spot, bean rust and other related diseases affecting bean. Correa et al. (1989) reported the increase in yield by 33-41% when multiple sprays of the systemic fungicide is done which is similar to these findings. Fluopyram 250g/L+Trifloxystrobin 250G/Lconsisting of new combination of Fluopyram 250G/L+Trifloxystrobin 250G/Lcan be considered as alternative to other fungicides because continuous application of same fungicides for several seasons may result into building up of pathogen resistances to the fungicides.

CONCLUSIONS & RECOMMENDATION

Angular leaf spot and bean rust are considered as most serious foliar diseases of common beans (*Phaseolus vulgaris* L.) has been effectively controlled with combination *of* Fluopyram 250G/L+Trifloxystrobin 250G/L. L). Because of its excellent performance, Fluopyram 250G/L+ Trifloxystrobin is hereby recommended for use in Tanzania to control angular leaf spot, bean rust and other related diseases affecting bean and should be applied at the dose rate of 0.2L/ha and 0.3L/ha when the diseases pressure is low and higher respectively.

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