

Management of Anthracnose in Soybean using Fungicide

Subash Subedi^{1*}, Dhan Bahadur Gharti¹, Saraswati Neupane² and Teknath Ghimire¹

¹ Grain Legumes Research Program, Khajura, Banke, Nepal

² National Maize Research Program, Rampur, Chitwan

* Corresponding author: subedi.subash1@gmail.com

Received April 2015; Revised June 2015; Accepted June 2015

Scientific Editor: B. Chaudhary

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ABSTRACT

Experiments on soybean (*Glycine max* L. Meril) were carried out aiming to control anthracnose (pod blight) caused by fungus, *Colletotrichum truncatum* with five treatments represented by different fungicidal sprays against control receiving no spray with three replicates of each under field conditions during two consecutive years from 2012 to 2013. In 2012, the higher Percent Disease Control (PDC) and Percent Yield Increase (PYI) were estimated in plot treated with SAAF (Carbendazim 12% + Mancozeb 63%) followed by Mancozeb fungicides. The mean Pod Infection (PI) was low in plots treated with SAAF followed by Mancozeb. Almost similar trends of disease control were observed in 2013. The lower Percent Disease Index (PDI) was 46.25% and mean PI was 29.67% with higher yield value of 2431.25 kg/ha obtained from the plots sprayed with SAAF then by Mancozeb. The results showed that, the combined treatment with fungicides, SAAF followed by Mancozeb were effective to control anthracnose or pod blight disease of soybean to increase the yield.

Key words: Anthracnose, fungicides, pod blight, soybean

सारांश

भटमास वालीमा कोलेटोट्रीकम ट्रन्काटम नामक हुँसीले लाग्ने कोसा डढ्ने रोग व्यवस्थापन गर्ने उद्देश्यले रामपुर चितवनमा सन् २०१२ देखि र २०१३ मा वजारमा उपलब्ध विभिन्न हुँसीनाशक विषादीहरूको रोग नियन्त्रण प्रभावकारिता परीक्षण गरिएको थियो। सन् २०१२ को वर्षायाममा हुँसीनाशक विषादी साफ (कारबेन्डाजिम १२% + म्यान्कोजेव ६३%) बाट उपचारित प्लटहरूमा रोग नियन्त्रण प्रभावकारिता ४२.१९% र उत्पादनमा वृद्धि १०८.६९% रहेको र त्यसपछि म्यान्कोजेवद्वारा उपचारित प्लटमा पनि केही पनि नछरेको प्लटभन्दा उच्च रहेको पाइयो। कोसामा देखिने रोगको संक्रमणको औषत प्रतिशत पनि क्रमशः साफ र म्यान्कोजेव द्वारा उपचारित प्लटमा क्रमशः कम (२२.३१% र २३.०४%) रहेको पाइयो। सन् २०१३ को परिक्षणमा पनि अघिल्लो वर्षको रोग व्यवस्थापनको आंकडा जस्तै नतिजा प्राप्त भयो। सबैभन्दा कम रोग र कोसामा रोगको संक्रमणको औषत प्रतिशत साथै उच्च उत्पादन क्रमशः ४६.२५%, २९.६७% र २४३१.२% के.जी. प्रति हेक्टर साफ द्वारा उपचारित प्लटमा पाइयो भने, त्यसपछि म्यान्कोजेव द्वारा उपचारित प्लटमा थियो। यसर्थ, दुई वर्षको परिक्षणको नतिजा अनुसार हुँसीनाशक विषादीहरू साफ र म्यान्कोजेव भटमासको कोसा कुहने रोग व्यवस्थापन साथै उत्पादन वृद्धिमा प्रभावकारी रहेको पाइयो।

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is an important summer legume of mid hill, grown as an intercrop with maize or in paddy bund that occupies about 80% in terms of total soybean area and production in Nepal (GLRP 2012). Soybean occupies an area of about 24934 ha with total production of 29221 mt with an average productivity of 1172 kg/ha (MoAD 2013), which is far less than global average productivity of 1.712 tons/ha (Masuda and Goldsmith 2008). For poor productivity prevailing diseases are one of the main reasons in Nepal. It is known that more than hundred pathogens affect soybean crop, some of them causing 10-12% yield losses (Mittal et al 1993). Among those Anthracnose disease caused by *Colletotrichum truncatum* in soybean is one of the most important seed-borne fungal pathogens appears late in season on stem, pods and seeds (GLRP 2011). The disease causes reduction of seed germination, seed quality and severe yield losses may occur in warm and humid regions of tropics and subtropics (Sinclair 1989) where soybean production is presently expanding.

In India, anthracnose is considered the most serious soybean disease (Khare and Chacko 1983). In the southern United States, this disease caused estimated yield losses ranging from 0.1 to 7.0% in the growing seasons (Koldenhoven et al 1983, Mulrooney 1985, 1986, 1988). Estimates of maximal seed yield reduction to anthracnose ranged from 16 to 26% in susceptible cultivars in Alabama (Backman et al 1982). Yield losses of 30 to 50% were reported in Thailand and 100% in India (Sinclair 1989).

Although several soybean lines were rated as resistant to the pathogen, no germplasm accessions tested so far have been shown to be immune (Manandhar et al 1988). *C. truncatum* is seed-borne and seed-transmitted disease which might cause systemic infection (Neergard 1979). The pathogen over-winter in crop debris (Athow 1973, Sinclair 1989) and several weed species may also serve as sources of inoculum (Hartman et al 1986, McLean and Roy 1988). Management of plant disease successfully achieved through application of chemical fungicides. Although, pod blight in soybean results in severe yield losses, however, very few works with respect to disease management have been carried out to cope of this disease in Nepal. So, the present experiment was undertaken to evaluate efficiency of available fungicides in market against soybean anthracnose disease under field conditions.

MATERIALS AND METHODS

The experiments were conducted during summer of 2012-2014 at Grain Legumes Research Program, Rampur, Chitwan by laying out in a well managed piece of land using Randomized Complete Block Design having five treatments with different fungicides against one control with four replicates of each. During soybean season, a susceptible variety Ransom was planted on second week of July in a unit plot size of 3m x 2m and 50 cm x 10 cm spacing. The fungicides were Dithane M-45 (Mancozeb 75% WP) @ 2.5 g/l, Krilaxyl (Metalaxyl

8%+ Mancozeb 64% WP) @ 2 g/l, Bavistin (Carbendazim 50% WP) @ 2g/l, Blitox-50 (Copper oxy chloride 50% WP) @ 3 g/l and SAAF (Carbendazim 12% + Mancozeb 63%) @ 2.5 g/l.

After completion of the sowing, the plots were kept under constant supervision from sowing to harvest. Agronomic practices were followed as recommended. First spray was given just after the appearance of disease symptom in the field. Three sprays were given at an interval of 15 days. Data were recorded before every spray using 1-9 scoring scale on 5 randomly tagged plants/plot. The control plots received no fungicides. Percent Disease Index (PDI) was computed according to the formula (Wheeler 1969) and calculation was based on the final data recorded at 15 days after the last spray.

Percent Disease Control (PDC) was calculated on the basis of the formula developed by Shivankar and Wangikar (1993). Early Plant Stand (EPS) and Final Plant Stand (FPS) were recorded. At harvest, data on total number of pod per plant, number of infected and healthy pods, 100 seed weight and seed yield were recorded with yield data presented in terms of hectare. Yield increase over the control was calculated. All data were analyzed statistically using MSTAT-C computer package program. Treatment means were compared using Least Significance Difference (LSD) and Duncan's Multiple Range Test (DMRT) at 5% levels of significance. The correlation among percent yield increased over control and percent disease control was calculated.

RESULTS

Efficacy of Fungicides In-vivo

The lower PDI with a value of 42.53% was recorded in plot treated with SAAF. The second most effective 47.25% of PDI was occurred in Mancozeb treated plants, while and highest value of 73.57% was in control. Final plant stand was also noticed higher in plot treated with SAAF in 47.25% while 45.75% in plots treated with Mancozeb. In SAAF treated plot the Percentage Disease Control (PDC) and Percent Yield Increase (PYI) were 42.19% and 108.69%, respectively followed by Mancozeb compared to control plot. The mean Pod Infection Percentage was noticed lower with a value of 22.31% in plot treated with SAAF followed by Mancozeb with 23.04% of value (Table 1).

Table 1. Effect of fungicides on pod blight disease severity and yield performance of soybean at Rampur, Chitwan, Nepal in 2012/13

Treatments	Early Stand	PDI (%)	Pod/plant	Final Stand	Yield Kg/ha	HSWT (g)	PI (%)	PDC (%)	PYI (%)
SAAF (2.5g/l of water)	50.25	42.53 ^c	51.50 ^a	47.25 ^a	1500.00 ^a	15.45 ^a	22.31 ^d	42.19	108.69
Mancozeb (2.5g/l of water)	46.75	47.25 ^c	48.50 ^{ab}	45.75 ^{ab}	1302.08 ^b	14.62 ^b	23.04 ^d	35.77	81.16
Krilaxyl (2g/l of water)	51.50	59.40 ^b	45.25 ^b	41.75 ^{ab}	1000.00 ^c	13.44 ^d	33.59 ^{bc}	19.26	39.13
Blitox-50 (3g/l of water)	46.50	48.60 ^c	47.50 ^b	42.75 ^{ab}	1062.50 ^c	13.97 ^c	32.82 ^c	33.94	47.83
Bavistin (2g/l of water)	42.75	68.62 ^a	32.00 ^c	40.00 ^{bc}	864.58 ^d	13.27 ^d	38.76 ^b	6.73	20.29
Control	51.25	73.57 ^a	25.25 ^d	34.00 ^c	718.75 ^e	12.41 ^e	73.92 ^a		
CV, %	12.40	8.73	5.71	10.37	7.81	1.17	9.93		
LSD (0.05)		7.46	3.58	6.55	126.42	0.24	5.60		

Means in column with same superscript is not significantly ($P < 0.05$) different by DMRT (Duncans Multiple Range Test), PDI- Percent Disease Index, FPS – Final Plant Stand/Plot, Yield (Kg/ha) - Grain yield in Kilogram per hectare, HSWT (gm) - Hundred Seed Weight in gram, PI% - Mean pod infection percentage, PDC - Percent Disease Control, YI - Yield Increase, g/lit – Gram per litre

Relationship between Percent Disease Control (PDC) and Percent Yield Increase (PYI)

In year 2013, the trends of disease control and yield observations were almost similar comparing to previous year. The PDI, number of pods per plant, final stand, yield, 100 seed weight and mean pod infection were significantly ($P < 0.05$) varied with the treatments. The lower (46.25%) PDI was recorded on plots sprayed with SAAF, the values increased when treated with Mancozeb having a value of 53.42% and then others. The maximum Mean Pod Infection percentage of 75.94% was recorded in control plot, while minimum in SAAF treated plot having a value of 29.67% and then in plot treated with Mancozeb (with a value of 33.15%), respectively. The yield of 2431.25 kg/ha and seed weight of 13.52 g/100 were also significantly ($P < 0.05$) higher in plots treated with SAAF and then by Mancozeb sprayed plots. The lower yield was recorded from control plot (743.75 kg/ha) (Table 2).

A linear negative correlation between yield and PDI was observed representing the best fit having $R^2 = 77\%$ (Figure 2). Obviously the yield decreased with the increase in Percent Disease Index (PDI). The linear correlation between PDC and PYI showed positive correlation ($R^2 = 0.796$) (Figure 1) showing that control in disease enhance the yield.

Table 2. Influence of fungicides on pod blight disease severity and yield performance of soybean at Rampur, Chitwan during 2013/14

Treatments	Early Stand	PDI (%)	Pod/plant	Final stand	Yield kg/ha	HSWT (g)	PI %	PDC (%)	PYI (%)
SAAF (2.5 g/l of water)	147.25	46.25 ^d	48.90 ^a	149.00 ^a	2431.25 ^a	13.52 ^a	29.67 ^b	37.13	226.89
Mancozeb (2.5 g/l of water)	153.75	53.42 ^c	46.07 ^{ab}	139.50 ^b	1522.06 ^b	12.60 ^b	33.15 ^b	27.38	104.64
Krilaxyl (2 g/l of water)	168.50	54.22 ^c	43.42 ^{bc}	131.75 ^c	1430.31 ^d	11.65 ^c	35.71 ^b	26.30	92.31
Blitox-50 (3 g/l of water)	169.75	53.58 ^c	45.25 ^{abc}	134.00 ^{bc}	1477.19 ^c	12.50 ^b	34.04 ^b	27.17	98.61
Bavistin (2 g/l of water)	176.25	65.07 ^b	41.97 ^c	128.50 ^c	1373.55 ^e	11.49 ^c	36.21 ^b	11.55	84.67
Control (Untreated check)	158.00	73.57 ^a	34.00 ^d	107.75 ^d	743.75 ^f	9.38 ^d	75.94 ^a		
CV, %	9.04	4.01	5.52	2.93	1.59	1.91	18.34		
LSD (0.05)		3.48	3.60	5.82	35.86	0.34	11.28		

Means in column with same superscript is not significantly ($P < 0.05$) different by DMRT (Duncans Multiple Range Test) PDI- Percent Disease Index, FPS – Final Plant Stand/plot, Yield (kg/ha)- Grain yield in Kilogram per hectare, HSWT (g)- Hundred Seed Weight in gram, PI% - Mean pod infection percentage, PDC- Percent Disease Control, YI- Yield Increase.

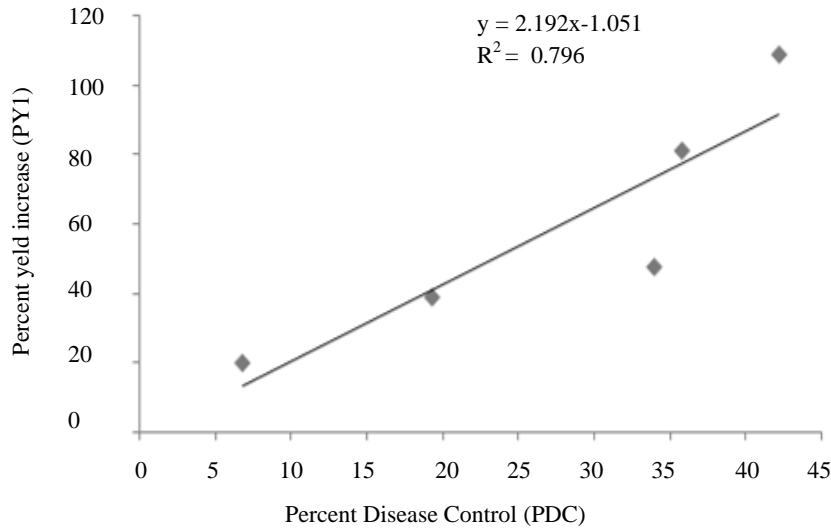


Figure 1. Relationship between PDC and PYI of fungicides used in soybean anthracnose.

DISCUSSION

Chemical treatment is one of the most recommended methods used for plant disease management. The present experiments with various available chemicals on Soybean crop for two consecutive years clearly showed low Percent Disease Index (PDI) and higher yield from the plot treated with SAAF (Carbendazim 12% + Mancozeb 63%) @ 2.5 g per litre of water comparing to control. This findings is in close agreement with Chakraborty and Shyam (1988) and (Ghawde et al 1996), who showed that fungicide Carbendazim was inhibitory to the *Colletotrichum lindemuthianum* causing anthracnose to French bean, *C. truncatum* The fungi *Colletotrichum graminicola* and *C. capsici* cause blight in bitter gourd (Singh and Dwivedi 2002, Dubey and Ekka 2003) while, *C. gloeosporioides* causes anthracnose in mango (Kumar et al 2003). Application of fungicides to control anthracnose disease of soybean reduces the yield losses (Backman et al 1982). Efficacy of fungicides in controlling anthracnose disease and increasing the yields were reported earlier (Khare et al 1972, Chaudhary 1977, Palarpawar and Ghurade 1989, Kumar and Mukhopadhyay 1990, Bhardwaj and Thakur, 1991, Shukla and Singh 1993, Dubey and Ekka 2003, Ekbote 2005).

It is clear that soybean sprayed with fungicides had lesser disease severity with increase in yield than untreated ones. The SAAF and Mancozeb @ 2.5 g/l of water were found best among the sprayed fungicides. The lesser percent disease index, lower mean pod infection percentage along with the higher yield and 100 seed weight was found from the plot applied with SAAF followed by Mancozeb. It is recommended that soybean field should be sprayed by SAAF @2.5 g/l of water twice at vegetative and pod formation stage against anthracnose/pod blight disease for maximum yield with the reduction of disease severity.

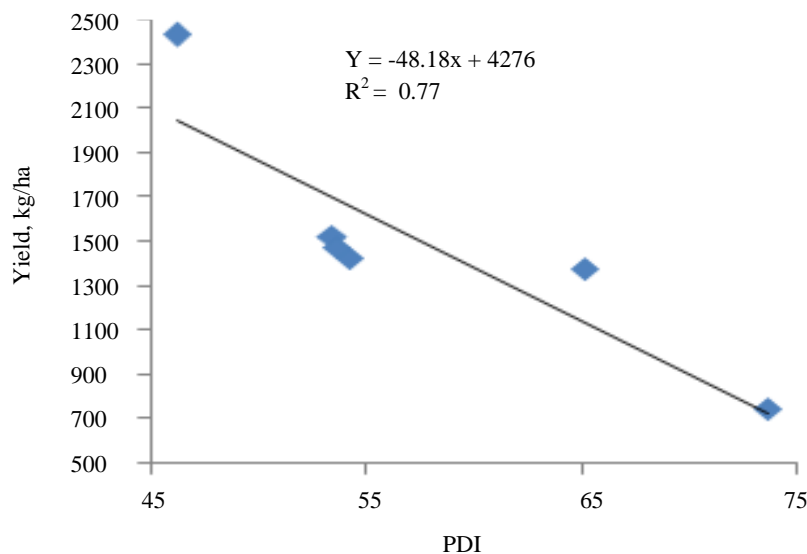


Figure 2. Relationship between Percent Disease Increase (PDI) and yield of soybean.

ACKNOWLEDGEMENTS

Thanks to Grain Legume Coordinator for continuous support and facilities. Plant Pathologists of NARC are also acknowledged for their valuable suggestions. The fund for this research was supported from Nepal Agricultural Research Council.

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