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Research Paper

Application of biodynamic preparation, bio control agent and botanicals for organic management of virus and leaf spots of blackgram *(Vignamungo* L. Hepper*)*

Amit Trivedi[1], Sandeep K. Sharma[2], T. Hussain[3], S. K. Sharma[2] and P. K. Gupta[4]

[1]Department. of Plant Pathology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udiapur (Rajasthan), India.
[2]Directorate of Research, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udiapur (Rajasthan), India.
[3]Department. of Entomology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udiapur (Rajasthan), India.
[4] Zonal Director Research, ARS, Udaipur, (Rajasthan), India.

*Corresponding author. E-mail: amit2trivedi@gmail.com.

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ABSTRACT

A study was conducted at Instructional Farm, Rajasthan College of Agriculture of Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) during *kharif* 2010 and 2011. Blackgram or Urd bean is the fourth important pulse crop in India. This study was conducted to develop package of practice for production of organic blackgram. The objective of this field study was to develop an organic plant protection module for management of yellow mosaic virus and three leaf spot diseases *viz* Anthracnose (*Colletotrichum lindenuthianum*), *Cercospora* leaf spot (*Cercospora canescens*) and Alternaria leaf spot (*Alternaria spp.*) of blackgram through biodynamic preparation - BD 501, Bio control agent – *Ampelomyce quisqualis* and botanicals *viz* neem oil, mustard oil and azadirachtin. Neem cake was also used to manage soil borne insects. The pooled data of 2010 and 2011 reveal that viral disease in various treatments ranged between 2.96 to 3.18% while in the untreated control it was 5.94%. The mean minimum percent disease index (PDI) of leaf spots was 28.13% while maximum seed yield was 9.50 q/ha, observed in treatment with spray of BD 501 followed by neem oil 29.38% PDI and seed yield 8.74 q/ha, while maximum PDI could be seen in untreated control (62.75%) with minimum seed yield 7.59 q/ha. Integrated use of biodynamic preparation - BD 501 and botanical neem oil resulted not only into the maximum increase in yield attributes and yield but also significantly reduced the disease incidence of black gram under organic production system.

Key words*:* Black gram, biodynamic preparation –BD 501, neem oil, yellow mosaic virus, leaf spot, anthracnose, cercospora leaf spot and alternaria leaf spot.

INTRODUCTION

Interest in food production without synthetic fertilizers and pesticide practices are increasing. Such food is commonly referred to as organic (Ramesh et al., 2009). Various organic technologies have been utilized for about 600 years to make agriculture sustainable while conserving soil, water energy and biological resources (Pimentel et al., 2005). Organic farming is gaining gradual momentum across the world. In India, about 528171 hectare area is under organic farming with 44,926 numbers of certified organic farms (Willer, 2008). Biodynamic farming, that is, combining biological and dynamic agriculture practices, has recently emerged as an advancement of organic agriculture. Organic farming, the product of biodynamic agriculture are nutritionally superior and they taste better than the conventional food (Steiner, 1996), besides having the potential to mitigate some of the negative effects of chemical agriculture. The biological practices usually include a series of organic farming techniques that improve soil health while the dynamic techniques promote the metaphysical aspects of the farm, e.g. planting seeds during

certain lunar phases to adapt to the natural rhythms of the planetary system (Pfeiffer, 1984).

India currently export approximately 300 tones pulses (APEDA, 2011). Black gram *(Vigna mungo* L. Hepper*)* is one of the most important pulse crops of India and state of Rajasthan dominates in production of black gram in India. Pulse production in Rajasthan is covering an area of about 3.10 million ha and producing 1.40 million tonnes. Being a cash crop, there is a great demand of organic black gram. Sustainable blackgram production is continuously challenged by diseases that cause quantitative and quail-tative losses in yield. Most wide spread among these are foliar diseases that is, yellow mosaic virus and three leaf spot diseases *viz* Anthracnose (*Colletotrichum lindenuthia-num*), *Cercospora* leaf spot (*Cercospora canescens*) and Alternaria leaf spot (*Alternaria spp.*) under favorable conditions these cause substantial losses and may become destructive at all the growth stages of the crop.

Organic pulses in Rajasthan represent a very negligible part of our total Pulse production. One of the constraints in increasing the area under organic pulses production is lack of suitable organic production practices for different agro-climatic regions. The present investigation was aimed to study the influence of certain biodynamic practices, use of BCAs and botanicals for control of diseases and yield of blackgram in southern Rajasthan.

MATERIALS AND METHODS

The experiment was conducted for two consecutive years during kharif, 2010 and 2011 at Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan). The region enjoys a semi-arid climate characterized by extremes of temperature both in summer and winter with average annual rainfall of about 600 mm that is mostly received in rainy season from July to September. The soils of the experimental fields were sandy-loam in texture and slightly alkaline (pH 7.9) in reaction. The soil was low in organic carbon (0.42), available nitrogen (223.42 kg ha-1) and medium in available phosphorus (13.52 kg ha-1), high in available potassium (218.54 kg ha-1).

Both the years that is, in *Kharif* 2010 and 2011 the trial was laid out at the Agronomy farm, RCA, with plot size 5 × 5 m, and four replications following a Randomized Block Design. In order to restrict soil born insets, a common treatment of neem cake at 2 q/ha was added and thoroughly mixed in treatment plots except untreated control plot. Seeds of Black gram variety T-9 were sown in all treated as well as untreated control plots. One foliar spray of BD-501 (1g/13 L) at 20 days after sowing (DAS) + One foliar spray of neem oil at 2% were applied commonly at 25 plots. For management of leaf spot diseases, two foliar spray treatments with different organic inputs viz. BD- 501 (1 g/13 L), neem oil (2 ml/L), mustard oil (2 ml/L), *A. quisqualis* (2.5 g/L), *Azadirachtin* (5 ml/L) and suitable untreated control were done. For foliar sprays a solution of desired quantity of organic treatment inputs was made. Two spray treatments were given first on appearance of disease and second at 15 days interval. A water volume of 600 lit/h was sprayed with the help of knapsack sprayer. The crop was harvested when leaf turns yellow and about 75% pods were fully matured. Manual harvesting of crops was done.

Observations for viral infection were recorded by counting total number of plants per plot and number of infected plants moreover the percentage of viral infected plants was calculated per plot. Final observations for leaf spot diseases were recorded at 10 days of 2rd spray. Disease observations were recorded on 0-5 disease rating scale on ten randomly selected plants per plot and PDI was calculated using following formula:

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of all individual disease rating}}{\text{Total no. of plants assessed} \times \text{Max. rating}} \times 100$$

Preparation and application of the biodynamic preparation – BD 501

Two biodynamic formulations (BD 501) sourced from the SUPA Biotech (P) Ltd., Nainital, India were tried. BD 501 is "cow horn silica" and is made from quartz crystals ground to alum power consistency, stuffed into a cow horn, buried during spring equinox, and taken out during autumn equinox. The material, stored in glass bottle, and exposed to the sun by the windowsill was used to prepare the BD 501 spray solution by dissolving 2.5 g in 40 L of water, which was prepared for spray within an hour, the mixture was sprayed as a fine mist on the plant foliage (that is before 9.00 am). The application dates corresponded to days when moon was opposite to Saturn in the biodynamic calendar.

RESULTS

Disease Incidence

The pooled data of two years reveal that viral disease in various treatments ranged between 2.96 to 3.18% while in the untreated control it was 5.94%. The differences of the percentage of infected plants among the treatments was non significant but was significant over untreated control. This may be due to a uniform neem oil treatment in all the plots of different treatments except the untreated plots where the percentage of infected plants was highest, 5.94% (Table 1).

Observations reveal that three leaf spot diseases *viz* Anthracnose (*C. lindenuthianum*), *Cercospora* leaf spot (*C. canescens*) and Alternaria leaf spot (*Alternaria spp.*)

Table 1. Control of viral, leaf spot and powdery mildew of Black gram under organic farming (pooled data of two years viz. Kharif 2010 and 2011).

Treatments	Viral (%)	Plant Height (cm)	Pods/plant	Seed/pod	Test weight (g)	Disease Leaf Spot (PDI)	Yield (quintals /ha)	Net Returns Rs.	Cost- benefit ratio(B:C) ratio
Foliar sprays of BD - 501 (1g/13 L).	2.97 (9.87)	54.03	17.88	6.58	61.01	28.13 (31.98)	9.5	23966	2.24
Foliar sprays of neem oil (2ml/L).	3.16 (10.12)	52.54	17.48	6.38	60.38	29.38 (32.81)	8.7	20559	1.82
Foliar sprays of mustard oil (2ml/L)	2.96 (9.78)	51.66	17.15	6.31	60.04	52.38 (46.37)	8.3	20089	1.93
Foliar sprays *Ampelomyces quisqualis* (2.5 g/L).	3.18 (9.99)	49.86	16.43	6.08	59.25	53.38 (46.94)	8.3	20002	1.93
Foliar sprays of neem formulation (*Azadirachtin* at 5 ml/L).	3.00 (9.84)	48.61	16.04	5.56	54.93	55.25 (48.03)	7.9	17561	1.68
Control	5.94 (13.82)	44.81	14.11	5.08	52.43	62.75 (52.48)	7.5	17356	1.55
CD	1.45 (2.02)	3.43	0.81	0.39	3.08	6.31 (3.72)	0.66	2377	0.22

*Soil application of neem cake at 2q/ha (for soil borne insects) + One foliar spray of BD-501 (1g/13 L) at 20 DAS **+** One foliar spray of neem oil at 2% was applied at 25 days (for control of viral infection) in all the treatment plots except untreated control.

appeared as mixed infection in both the years that is, in *Kharif* 2010 and *Kharif* 2011. Different spray treatments exhibited significant effect on leaf spot incidence. Two spray treatments were given1st on appearance of disease and 2nd at 10 days interval. The pooled data reveal that the mean minimum percent disease index (PDI) was observed in treatment with spray of silicon BD (28.13%) followed by neem oil (29.38%), mustard oil (52.38%), *A. quisqualis* (53.38%), and *Azadirachtin* (55.25%) while maximum PDI could be seen in untreated control (62.75%). The difference in PDI in different treatments was found significant (Table 1).

In both the years due to constant and high rainfall during entire growing season upto harvesting, the powdery mildew appeared in traces very late that is, 1st week of October at maturity in untreated control plots only, treated plots did not exhibit any infection of powdery mildew so data are not shown in Table 1.

Yield and yield attributes

The pooled analysis of the data in 2010 and 2011 reveal that all the treatments resulted in higher seed yield over the untreated control. The maximum seed yield of 9.5 q/ha was obtained in spray with silicon BD followed by 8.7 q/ha in neem oil, 8.3 q/ha in mustard oil, 8.3 q/ha in *A. quisqualis*, 7.9 q/ha in *Azadirachtin* and lowest yield was observed in untreated control (7.5 q/ha). These differences were statistically significant (Table1). The number of pods/ plant was significantly higher in treatments over untreated control. There was significant difference in number of pods/plant observed within the treatments. The maximum number of pods/ plant in silicon BD was 17.88 pods/ plant followed by 17.48 pods/ plant in neem oil, 17.15 pods/ plant in mustard oil, 16.43 pods/ plant in *A. quisqualis*, 16.04 pods/ plant in *Azadirachtin* and lowest pod/ plant 14.11 was observed in untreated control (Table 1). There was significant difference in plant height (cm) observed within the treatments. The maximum plant height in silicon BD was 54.03 cm followed by 52.54 cm in neem oil, 51.66 cm in mustard oil, 49.86 cm in *A. quisqualis*, 48.61 cm in *Azadirachtin* and lowest plant height 44.81 cm was observed in untreated control (Table 1). There was significant difference in number of seeds/pod observed within the treatments. The maximum number of seeds/pod in silicon BD was 6.58 followed by 6.38 in neem oil, 6.31 in mustard oil, 6.08 in *A. quisqualis*, 5.56 in *Azadirachtin* and lowest number of seeds/pod 5.08 was observed in untreated control (Table 1). There was significant difference in test weight (1000 seed weight in grams) observed within the treatments. The maximum test weight in silicon BD was 61.01 g followed by 60.38 g in neem oil, 60.04 g in mustard oil, 59.25 g in *A. quisqualis*, 54.93 g in *Azadirachtin* and lowest test weight 52.43 g was observed in

untreated control (Table 1).

Economics

All the treatments resulted in higher net returns and cost-benefit ratio (B:C) ratio over the untreated control. The maximum net returns Rs. 23966/ha^{-1} was obtained in spray with BD 501 and lowest net returns was obtained from untreated control (Rs. 17356/- ha^{-1}). The maximum B:C ratio 2.24 was obtained in spray with silicon BD and lowest B:C ratio was obtained from untreated control (1.55). These differences were statistically significant (Table 1).

DISCUSSION

To put forth cause and effect relationship between biodynamic manures and plant development, previous evidences are cited here. The concept of biodynamic manure (BD 501) was originally given by Rudolf Steiner (Steiner, 1996) who showed that due to application of BD 500, significant internal changes do take place in the manure during overwintering in the soil. The principal changes are a significant drop in pH, an increase in aerobic status and production of nitrate. Another aspect is that there is in many case little evident of loss of organic matter. He also reported that application of BD 500 and BD 501 activate natural manure and humus content

Pfeiffer (1984) reported that spray of biodynamic manure BD 501 increases the photosynthesis, and as such compliment the activity of the preparation BD 500, which works mostly in the root zone of the plant. It also strengthens the plants against some fungus attack.

Jayasree and George (2006) reported that application of two biodynamic preparations (BD 500 and BD 501) in chilli by adopting a biodynamic calendar resulted in better fruit quality of chilli. Stever (1999) also reported the promo-tional effect of application of biodynamic prepara-tions on crop yield and soil qualities. Previous researches on effect of organic manures in enhancing crop and soil productivity have been reported by Liebig and Doran (1999), Pimentel et al. (2005), Ramesh et al. (2010) and Patil (2010). They have reported that importance of organic farming is understandable given the important role soil organic matter plays in maintaining soil productivity through multiple functions.

A number of plants found in India have been successfully used both for therapeutic as well as poisonous purposes (Chopra et al., 1965). The presence of antifungal compounds in higher plants is an important factor to disease resistance (Mahadevan, 1982) such compounds being biodegradable and selective in their toxicity are considered valuable for controlling some plant diseases. The inhibitory effects of the plant products on pathogen are attributable to the presence of some antifungal ingredients (Singh and Dwivedi, 1987). Khan and Rishi Kumar (1990) studied antifungal activity of leaf extract of neem (*Azadirachta indica*). Botanicals, particularly neem (*A. indica*) and vegetable oils have shown good fungicidal potential against many foliar pathogens of different crops as ecofriendly fungicide (Ranga Rao et al., 2007).

Previous studies have reflected that with respect to plant nutrients, having an appropriate balance of nutrients for crop growth at critical times in growing season is an essential feature for sustained growth and promotional effect on crop yield (Doran et al., 1987; Friend, 1992; Wander et al., 1994; Ramesh et. al., 2009). In light of the above evidences, it seems that application of biodynamic preparation - BD 501 and botanical neem oil resulted not only into the maximum increase in yield attributes and yield but also significantly reduced the disease incidence of black gram under organic production system.

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