Evaluation of Fungicides, Organic Amendments and Botanicals against Powdery Mildew of Black Gram in Field Condition

Abstarct

The black gram [*Vigna mungo* (L.) Hepper] is a protein rich *kharif* pulse crop in India. Powdery mildew of black gram is an important disease caused by obligate fungus *Erysiphe polygoni.* It causes both quantitative and qualitative losses of grains. The fungicides, botanicals and organic amendments which found best effective were further tested as foliar spray alone as well as in integration of each other for powdery mildew disease suppression. The susceptible black gram variety 'PU 31' was used for this experiment. Lowest powdery mildew severity (PDI) after third spray (10.67%) with maximum PEDC (85.19%) of powdery mildew disease and 9.3 q/ha black gram yield was recorded by foliar spray of Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] 0.1%+ Neem leaf extract 5% + Panchgavya 10% as compared to control with highest (72%) powdery mildew disease severity with lowest 4.12 q/ha yield.

Keywords- Powdery mildew, Black gram, Evaluation, *Erysiphe polygoni* and Field condition, Botanicals, Fungicides, Organic Amendments

Introduction

Black gram [*Vigna mungo* (L.) Hepper] is the most important grain legumes. It is from *Fabaceae* family with 2n=22 Chromosomes and it is believed to have originated in India (Chatterjee and Bhattacharya, 1986). Black gram cultivation is suitable for hot and moist weather condition. Black gram is well known protein rich *kharif* pulse crop in India, which is approximately three times richer than cereals (Kanade, 2006). It is the most important pulse crop in India as it is produced about 2.83 million tonnes annually from about 44.78 lakh hectares of area and an average productivity is 632 kg per hectare (Anon., 2017a). Powdery mildew of black gram incited by *Erysiphe polygoni* (De Candolle) is the major problem in black gram production, ~~it~~ which causes both quantitative and qualitative losses of grains. This disease has been observed severe mainly in late sown *kharif* crop and remains active throughout the year. The powdery mildew disease interferes in photosynthetic activity and causes significant physiological changes in plants, which causes reduction in yield (20-40 per cent) depending on the stage and time at which the disease appears (Legapsi *et al*., 1978; Singh, 1995).

Material and methods

The investigations on Management of Powdery Mildew of Black Gram Caused by *Erysiphe polygoni* DC" was conducted during *Kharif* 2018. The laboratory studies were carried out in the Plant Pathology Department and the field experiments were conducted at agronomy farm of RCA, MPUAT, Udaipur. The detailed information of experimental techniques and materials used for these studies are described below.

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Comment [h4]: Meaning not clear...revise this sentence.....as per methodology, first you tested all these products in laboratory and then go for fi efficacy....but in abstract it is not cleared like that....Further, the results of Laborat experiment is not mentioned in manuscript.....so, here no need to ment the laboratory exp....also remove from a places M & M...R & D

Comment [h5]: Elaborate this short forms and write in bracket

Comment [h6]: Don't write the trad name...only technical names of any pesticides have to mention in research paper....do this in all places in manuscrip

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Comment [h9]: Very old data ....add recent data...upto 2023

Comment [h10]: Add the aim and scope of study at the end of introduction.....revise the introduction section....introduction is very poor

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All the chemicals and fungicides used for studies work were of 'Analar' grade quality. The chemicals Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] manufactured by the company Syngenta India Limited, Boon 10% WP (Mycobutanil) from Indofil Chemicals Company, Contaf 5 % EC (Hexaconazole) from Chemet Chemicals Pvt., Ltd., and Tilt 25% EC (Propiconzole) from Canary Agro Chemicals Pvt., Ltd were used. The organic amendments (Panchgavya, ~~B~~butter milk and ~~V~~vermiwash) were obtained from Organic ~~f~~Farming unit, Rajasthan C~~o~~ollege of A~~a~~griculture, MPUAT, Udaipur and botanicals (~~N~~neem leaf extract and Parthenium leaf extract) were prepared by fresh leaves.

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Preparation of botanicals and organic amendments: - ~~For the preparation of fresh botanicals solution,~~ Fresh leaves were collected from the healthy plants, ~~they first were~~ washed in tap water and then in distilled water. The 100-gram ~~healthy plant~~ leaves were crushed in 100 ml of sterile water (1:1 w/v) and the material was homogenized for five minutes in mortar and pestle and then the mixture was filtered through two layers of muslin cloth (Sindhan *et al*., 1999). The obtained extract was considered as a standard (100%) extract and used as a stock solution. Two, five, seven, ten and fifteen per cent concentration of each botanical ~~were~~ was prepared by mixing two, five, seven, ten and fifteen ml of stock solution in 98, 95, 93, 90 and 85 ml of sterilized distilled water, respectively. The stock solution of vermiwash, *panchgavya* and buttermilk were ~~obtained from organic farming unit, Rajasthan College of Agriculture, Udaipur, and their~~ also prepared at different concentrations *viz*., 2, 5, 7, 10 and 15%) ~~were prepared~~ in distilled water.

~~Evaluation of fungicides, organic amendments, and botanicals against powdery mildew of black gram in field~~ Field studies: Based on the laboratory studies one fungicide ~~Taspa 300 SC [~~Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1%, one botanical Neem leaf extract @ 5% and one organic amendment Panchgavya @ 10% that found most effective was further evaluated in field condition alone as well as their integration for management of black gram powdery mildew. The field experiment was conducted in Randomized block design (RBD) with eight treatments having three replications *viz*., T_1 ~~(Taspa~~ 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1%), T_2 (Neem (*Azadiracta indica*) leaf extract@ 5%), T_3 (Panchgavya @10%), T_4 (~~Taspa~~ 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1% + Panchgavya @ 10 %), T_5 (~~Taspa~~ 300 [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] SC @ 0.1% + Neem (*Azadiracta indica*) leaf extract @ 5%) T_6 (Neem (*Azadiracta indica*) leaf extract @ 5% + Panchgavya @ 10%), T_7 (~~Taspa~~ 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1% + Neem (*Azadiracta indica*) leaf extract @ 5% + Panchgavya @ 10%) and T_8 (Control). The powdery mildew susceptible black gram variety "PU 31" was sown at 30 cm × 10 cm spacing in 1.8 m × 1.9 m plot size.

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The percent disease index (PDI) was calculated by using following formula given by Wheeler, 1969:

$$PDI = \frac{\text{Sum of all individual disease ratings}}{\text{---------- x 100}}$$

No. of leaves observed x Maximum disease grade

The per cent efficiency of disease control (PEDC) was determined by using following formula:

$$PEDC = \frac{\text{Per cent disease index in control - Per cent disease index in treatment}}{\text{Per cent Disease Index in control}} \times 100$$

Results & Discussion

The black gram [*Vigna mungo* (L.) Hepper] is a protein rich *kharif* pulse crop in India. Powdery mildew of black gram is an important disease caused by obligate fungus *Erysiphe polygoni.* It is widely prevalent in warm and humid region of Southeast Asian countries including India and in dry season it becomes severe causes 9-50% yield loss (Reddy *et al*., 2008 and Pandey *et. al*., 2009). The symptoms of powdery mildew caused by *Erysiphe polygoni* were first observed on the lower leaves at flowering stage. Symptoms first appeared as small, white powdery colonies on upper surface of infected leaves. When the disease progressed, these white powdery patches enlarge and joined together and cover both the surfaces of infected leaves. In the later stages the white patches turn dirty greyish and dry. Similar symptoms of powdery mildew caused by *E. polygoni* were also reported by Raut *et al.,* 1986 on stem and leaves of black gram and green gram at flowering stage.

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In the present study five fungicides Taspa-300 SC (Propiconazole13.9% + Difenconazole13.9%), Mycobutanil, Hexaconazole, Karathane and Propiconazole were tested at three concentrations *viz*., 0.05%, 0.1% and 0.2% using spore germination technique against *E. Polygoni in vitro*. Among the fungicides new combi-fungicide Taspa-300 SC significantly cause maximum 93.05, 92.1 and 89.23% inhibition of spore germination with minimum 5.32, 6.05 and 8.24 % spore germination at 0.2, 0.1 and 0.05% concentration. Followed by Hexaconazole was found effective at all concentration and it cause 90.2 per cent inhibition with 7.50% spore germination at 0.2% concentration. Taspa-300 SC is a combi-fungicide of two fungicides Propiconazole and Difenconazole and both are extensively used to control many pathogens and foliar disease *in vitro* as well as *in vivo* condition (Channamma *et al*., 2015; Chavan *et al*., 2014 and Kumawat *et al*., 2016). These results of present study were also agreements with the field results of (Karmakar *et al*., 2016 and Verma *et al*., 2018) both reported that the Taspa (Propiconazole 13.9% + Difenconazole 13.9%) significantly controlled the grain discolouration disease of rice and spot blotch (*Bipolaris sorokiniana*) of wheat.

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Two botanicals (Neem (*Azadiracta indica) and* Parthenium *(Parthenium hysterophorus*)) and three organic amendments/ bio-rationals (Panchgavya, Butter milk and Vermiwash) were tested *in vitro* at 2, 5, 7, 10 and 15% concentration using spore germination technique against *E. polygoni*. In both botanicals, maximum inhibition of spore germination over control was recorded in Neem (*Azadiracta indica*) leaf extract at all concentration. Neem leaf extract at 15% and 10% caused maximum 62.14 and 59.18 per cent spore

inhibition with lowest 28.32 and 30.53 per cent spore germination respectively. Similar, reports have been quoted by Jyothi (2012) that the Neem leaf extract caused maximum 49.42 % inhibition of conidial germination at 10 per cent concentration and found effective against powdery mildew of green gram followed by *Parthenium hysterophorus* at 10 % with 38.20 per cent inhibition of conidial germination. Khunt *et al.* (2017) reported that the neem leaf extract (10%) was most effective in spore germination inhibition (83.05%) followed by Garlic @ 10% 81.21 per cent inhibition of spore germination against powdery mildew (*E. polygoni*) of cumin i*n vitro*.

In bio-rationales/organic amendments application of Panchgavya 15% diluted liquid suspension was caused maximum spore inhibition per cent (59.22) with 30.50 per cent spore germination followed by Vermiwash 15% inhibition (56.09%) with 32.86 per cent spore germination. Panchgavya at 10% concentrationwas also found superior among all bio-rationales with maximum (57.02%) spore inhibition and minimum 32.15% spore germination. Antifungal potential of Panchgavya against many pathogens of various crops has been reported by several workers that were similer to the results obtained in present study (Sugha 2005; Sumangala and Patil 2009 and Ramya 2014). Sumangala and Patil (2009) evaluated Panchagavya *in vitro* against *Curvularia lunata* causing brown leaf spots in rice. The results revealed that the Panchagavya inhibit 95.90 per cent spore germination and 86.30 per cent mycelial growth of *Curvularia lunata*. Sugha (2005) evaluated the antifungal potential of panchgavya against *Sclerotium rolfsii*, *Fusarium solani*, *Sclerotinia sclerotiorum*, *Rhizoctonia solani* and *Phytophthora colocasiae* and advocated that the mycelial bits dipped for 6 hours in panchgavya caused complete suppression of mycelial growth of *R. solani* and in other pathogens, the growth inhibition ranged between 88.1- 92.3 per cent.

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Table-1. Management of powdery mildew (*E. polygoni*) of black gram in field

Sr. No.	Treatments	*PDI before 1st spray	PDI* After sprayings			PEDC** after spraying			Yield g/plot	Yield q/ha
			First	Second	Third	First	Second	Third		
1	Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1%	9.33 (17.18)	32.00 (34.44)	28.00 (31.94)	22.67 (28.4)	17.24 (24.52)	48.78 (44.28)	68.52 (55.85)	214	6.27
2	Neem leaf extract @ 5%	9.33 (17.70)	37.33 (37.64)	34.67 (36.05)	30.67 (33.60)	3.45 (10.69)	36.59 (37.21)	57.41 (49.24)	190	5.57
3	Panchgavya @ 10%	12.00 (20.08)	36.00 (36.86)	33.33 (35.24)	29.33 (32.77)	6.90 (15.20)	39.02 (38.64)	59.26 (50.32)	199	5.83
4	Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1% + Panchgavya @ 10 %	10.67 (18.45)	24.00 (29.32)	20.00 (26.55)	14.67 (22.47)	37.93 (38)	63.41 (52.76)	79.63 (63.15)	277	8.09
5	Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1% + Neem leaf extract @ 5%	8.00 (16.42)	28.00 (31.94)	24.00 (29.32)	18.67 (25.56)	27.59 (31.67)	56.10 (48.48)	74.07 (59.37)	241	7.05
6	Neem leaf extract @ 5% + Panchgavya @ 10%	13.34 (21.36)	34.67 (36.05)	30.67 (33.60)	26.67 (31.06)	10.34 (18.75)	43.90 (41.48)	62.96 (52.49)	205	5.98
7	Taspa 300 SC [Propiconazole (13.9%) 15% W/V + Difenconazole (13.9%) 15% W/V] @ 0.1% + Neem leaf extract @ 5% + Panchgavya @ 10%	8.00 (16.07)	20.00 (26.56)	16.00 (23.57)	10.67 (18.98)	48.28 (44)	70.73 (57.23)	85.19 (67.34)	318	9.3
8	Control	12.00 (20.26)	38.67 (38.43)	54.67 (47.66)	72.00 (58.03)	0	0	0	141	4.12
	SEm±	2.33	0.47	0.60	0.92	0.34	0.18	0.01	0.77	0.01
	CD*(P=0.05)*	N/A	1.45	1.83	2.82	1.06	0.55	0.05	2.35	0.04

*Per cent disease index; **Per cent efficiency of disease control; Mean of three replications, Figures given in parentheses are arcsine √ Per cent angular transformed values