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Influence of various cropping systems on disease severity of *Cercospora* leaf spot, anthracnose and powdery mildew diseases of blackgram

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Abstract
Cropping systems have a large effect on the size of the primary inoculum and its localisation, on the development and spread of epidemics and on the coordination of the life cycle of cultivated plants and that of their parasites. Hence to know the influence of four different cropping systems (Natural farming (ZBNF), Package of practice, Organic farming and Farmer's practice) a field experiment was conducted at Seed farm, Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi, Karnataka during *summer* 2020 to investigate the influence of different cropping systems on disease severity of *Cercospora* leaf spot, anthracnose and powdery mildew of blackgram. Among the 4 treatments Package of practice showed lowest PDI of powdery mildew, anthracnose and *Cercospora* leaf spot after 2 sprays (14.50%, 24.20% and 21.14% respectively). Natural farming and Organic farming showed significant difference in PDI with Farmer's practice in case of all the three diseases.

Keywords: Cropping system, farmer's practice, natural farming, package of practice

Introduction
Blackgram (*Vigna mungo* (L.) Hepper) commonly known as urd bean, mash, black maple is an annual, semi erect to spreading herb belonging to the family *Fabaceae* is grown as a *Kharif* crop in tropical and subtropical countries. Urd bean has high nutritional value containing protein (24%), fat (1.4%), carbohydrate (59.6%), calcium (154 mg), phosphorus (385 mg), iron (9.1 mg), beta carotene (38 mg), thiamine (0.4 mg), riboflavin (0.37 mg) and niacin (2 mg) per 100 g seeds. Sustainable black gram cultivation is continuously challenged by diseases that cause quantitative and qualitative losses in yield. The microorganisms that are present internally or externally cause considerable damage. The major diseases *viz.*, Anthracnose (*Colletotrichum lindemuthianum*), Bacterial leaf blight (*Xanthomonas phaseoli*), *Cercospora* leaf spot (*Cercospora canescence*) and *Corynespora* leaf spot (*Corynespora casslicolli*), Powdery mildew (*Erysiphe polygoni*), Root rot and Web blight (*Rhizoctonia solani*) and Stem canker (*Macrophomina phaseolina*) are reported in this crop. Among these Anthracnose, Web blight and Powdery mildew causes heavy losses to the crop (Agarwal *et al*., 2019) [1].

Cropping systems have a large effect on the size of the primary inoculum and its localisation, on the development and spread of epidemics and on the coordination of the life cycle of cultivated plants and that of their parasites. They can disrupt ecological equilibria, either favouring or disfavouring the pathogens. By combining information concerning the effects of agricultural techniques on diseases and the physiological effects of diseases on growth and crop production, it is now possible to develop new crop management systems, in which the use of non-chemical methods for preventing diseases is a priority (Meynard *et al*., 2002) [2]. In this regard field experiment was conducted to evaluate influence of different cropping systems for 3 diseases appeared during the cropping period *viz.*, anthracnose, powdery mildew and *Cercospora* leaf spot of blackgram.

Material and Methods
A field experiment was conducted at Seed farm, Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi, Karnataka during *summer* 2020 in a Randomized Complete Block Design (RCBD) using Rashmi variety of blackgram in a plot size of 5.7 m × 5.1 m with spacing of 30 × 10 cm. Experiment consisted of four treatments and five replications, treatments included Palekar's method of Natural Farming (ZBNF), Organic Farming (OF),

Package of Practices (POP) and Farmer's Practice (FP). Crop was raised by following agronomic and plant protection practices according to these treatments. Details of cropping systems are as furnished in the Table 1.

Plant protection measures were taken up using 500 litres of spray solution per hectare according to the respective treatments. 2 sprays were given at 40 and 65 DAS for Powdery mildew, at 50 and 75 DAS for *Cercospora* leaf spot and Anthracnose diseases. Observations related to disease severity of powdery mildew was recorded at 40 DAS before spraying, 15 days after 1st spray and 15 days after 2nd spray whereas 50 DAS before spraying, 15 days after 1st spray and 15 days after 2nd spray in case of *Cercospora* leaf spot and Anthracnose diseases. The severity of all the three diseases was recorded by following 0-9 Scale (Mayee and Datar, 1986) [3] (Table 2), these scales were converted to per cent disease index (PDI) using the formula given by Wheeler (1969) [4]. Mean values of the PDI recorded was subjected to arcsine transformation for statistical analysis then the inference of the experiment was drawn based on the F test.

Table 1: Details of the Agronomic and plant protection practices followed for each cropping system

Treatments	Agronomic and plant protection practices
T1 - Natural Farming (ZBNF)	1. Application of Ghanajeevamruta @ 1000 kg per ha before sowing 2. Seed treatment with Beejamruta @ 50 litres per ha 3. Application of Jeevamruta @ 500 litres per ha at an interval of 15 days (6 times) 4. Mulching at 25 days after sowing of crop 5. Application of Neemastra @ 500 litres per ha against sucking pests (2 times) 6. 10 per cent 5 days fermented butter milk @ 500 litres per ha against all fungal diseases
T2 - Organic Farming (OF)	1. Application of FYM @ 10 tonnes per ha before sowing 2. Seed treatment with *Rhizobium* and PSB @ 200 g each per kg seeds 3. Application of Azadirachtin 0.03% against sucking pests and all fungal diseases (2 times)
T3 - Package of Practices (POP)	1. Application of FYM @ 5 tonnes per ha before sowing 2. Application of 25:50:25 kg NPK per ha at the time of sowing 3. Seed treatment with *Rhizobium* and PSB @ 200g each per kg seeds 4. Application of Dimethoate 30 EC @ 1.7 ml per litre against sucking pests (2 times) 5. Carbendazim 50% WP (0.1%) for powdery mildew disease, Hexaconazole 5% SC @ 1 ml per litre for *Cercospora* leaf spot and Anthracnose diseases
T4 – Farmer's Practice (FP)	1. No fertilizers and FYM applied 2. No spray for plant protection

Table 2: Disease severity scale for *Cercospora* leaf spot, Powdery mildew and Anthracnose of blackgram

Grade	Description
0	No symptoms on leaf
1	Up to 1% of leaf area covered by lesions
3	1-10% of leaf area covered by lesions
5	11-25% of leaf area covered by lesions
7	26-50% of leaf area covered by lesions
9	More than 50% of leaf area covered by lesions

$$PDI = \frac{\text{Sum of individul disease ratings X 100}}{\text{No. of observations assessed} \times \text{maximum disease rating}}$$

Result and Discussion

Slight differences were observed in disease incidence itself among the treatments in case of all the three diseases. The highest disease incidence was observed in farmer's practice. This may be attributed to no external application of nutrients or no practices to augment the availability of soil nutrients in this cropping system. Findings of Spann and Schumann (2009) [5] supports this result, they mentioned that plant nutrients may affect disease susceptibility through plant metabolic changes, thereby creating a more favorable environment for disease development.

According to the data presented in the Table 3 the highest PDI of the powdery mildew disease was observed in farmer's practice both at 15 days after first spray (31.05%) and 15 days after second spray (33.41%). The lowest PDI was observed in Package of practice after first as well as second spray (19.92% and 14.50% respectively). This result is in accordance with that of Jayasekhar and Ebenezar (2016) [6] who reported 19.60% PDI of blackgram powdery mildew in Carbendazim (0.1%) spray treatment.

Table 3: Per cent disease index of powdery mildew of black gram under different cultivation practices

Treatment	Per cent disease index		
	40 DAS (before spray)	15 days after 1st spray	15 days after 2nd spray
T1- Natural Farming (ZBNF)	25.34 (30.20)	23.38 (28.29)	19.40 (26.12)
T2- Organic Farming (OF)	26.79 (31.15)	22.16 (28.07)	21.05 (27.29)
T3- Package of practice (POP)	26.63 (31.05)	19.92 (26.49)	14.50 (22.38)
T4- Farmers practice (FP)	27.28 (31.07)	31.05 (33.85)	33.41 (35.27)
S. Em. ±	0.48	0.38	0.46
C.D. at 5%	1.47	1.18	1.41

Note: DAS-Days after sowing; Figures in parentheses are arcsine transformed values.

In case of Anthracnose and *Cercopsora* leaf spot disease of blackgram the lowest PDI was recorded in Package of Practice after first spray as well as second spray and the highest was observed in Farmer's practice as represented in Table 4. Kulkarni and Raja [7] during 2019 reported 19.85% PDI of greengram anthracnose by spray of Hexaconazole at 0.1% which supports the results obtained in the present investigation. The minimum disease intensity of *Cercospora* leaf spot in greengram and highest yield was reported by the application of Hexaconazole 0.1% (Uddin, 2013) [8].

Table 4: Per cent disease index of Anthracnose and *Cercospora* leaf spot of black gram under different cultivation practices

Treatment	Anthracnose			*Cercospora* leaf spot		
	Per cent disease index (PDI)					
	50 DAS (before spray)	15 days after 1st spray	15 days after 2nd spray	50 DAS (before spray)	15 days after 1st spray	15 days after 2nd spray
T1- Natural Farming (ZBNF)	24.91 (29.95)	29.47 (32.89)	31.18 (33.96)	21.43 (27.59)	23.03 (28.69)	26.15 (30.77)
T2- Organic Farming (OF)	23.90 (29.28)	27.66 (31.74)	32.91 (35.02)	20.94 (27.24)	24.39 (29.60)	25.33 (30.23)
T3- Package of practice (POP)	20.51 (26.94)	22.05 (28.02)	24.20 (29.48)	18.66 (25.60)	20.87 (27.19)	21.14 (27.38)
T4- Farmers practice (FP)	26.74 (31.15)	32.74 (34.92)	36.13 (36.96)	24.33 (29.56)	27.93 (31.91)	31.62 (34.23)
S. Em. ±	1.33	1.26	1.26	0.94	0.91	0.91
C.D. at 5%	4.11	3.88	3.88	2.90	2.82	2.82

Note: DAS-Days after sowing; Figures in parentheses are arcsine transformed values.

Both Natural farming and Organic farming showed significant difference in PDI with Farmer's practice in case of all the three diseases (Table 3 and 4). In concurrence with the results of Organic farming Kuepper (2003) [9] also stated that neem oil is effective and preventive fungicide used in the control of various diseases like leaf spot, *Alternaria* blight, rust, scab and flower, twig and tip blight, antraccnose and *Botrytis* blight. The inhibitory effect of neem extract on mycelial growth and sporulation of *Cercospora capsici* was reported by Singh *et al*. (1997) [10]. But there are no reviews pertaining to the effectiveness of 10 per cent 5 days fermented butter milk in controlling these diseases.

Conclusion

So it could be concluded that Package of practice is the best treatment for the management of powdery mildew, anthracnose and *Cercospora* leaf spot of black gram. Natural farming and Organic farming also has significant effect in reducing the severity of these diseases over Farmer's practice.

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