RESEARCH ARTICLE

EVALUATION OF SPRAY SCHEDULE INVOLVING FUNGICIDE, COMMERCIALLY AVAILABLE BOTANICAL AND ITK ON CURVULARIA LEAF SPOT OF MAIZE FOR YIELD AND QUALITY PARAMETERS

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Abstract: Highest per cent increase in grain yield over unsprayed control was recorded in the spray schedule hexaconzole @ 0.1 per cent - hexaconazole @ 0.1 per cent (52.80) followed by carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5 per cent (28.80), hexaconazole @ 0.1 per cent - wanis @ 0.5 per cent (26.74), and carbendazim + mancozeb @ 0.2 per cent- carbendazim + mancozeb @ 0.2 per cent (24.61). Least per cent increase in grain yield over unsprayed control was observed in spray schedule wanis @0.5per cent- wanis @0.5 per cent (10.34). The highest B: C was obtained with spray schedule hexaconazole @ 0.1 per cent - hexaconzole @ 0.1 per cent (1:3.81) followed by hexaconazole @ 0.1 per cent - wanis @ 0.5 per cent and carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5per cent both were recorded B:C (1:2.81). Most of the remaining spray schedules treatments, T_4, T_7, and T_2 recorded next highest B: C of 1: 2.71, 1:2.69, 1: 2.43 and 1: 2.42, respectively. Least B: C of 1:2.18 was recorded in unsprayed control.

Keywords: ITK, Botanical, Maize, Spray schedule

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world and ranks third next to wheat and rice. It is grown throughout the world under a wide range of climatic conditions. Since pre-Hispanic time, it has been the basic food for majority of the people in Mexico, Central America and Latin America. Maize was introduced to India from America at the beginning of 17th century. In addition to staple food for human being and quality feed for animals, it serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries *etc.* In the last one decade, it has registered the highest growth rate among all food grains including wheat and rice because of newly emerging food habits as well as enhanced industrial requirements.

In India, it is cultivated both as food and fodder crop. It has got immense potential and hence called as 'Miracle crop' and also called as 'Queen of cereals'. In the future, maize demand is expected to increase, mainly because it is used by larger population as human food and due to its increased consumption as feed in poultry for animal protein. Besides multiple uses contribute to diet diversification and improved nutrition in human beings through exploitation of quality protein maize (Singhal, 2003). Every part of the maize plant has economical value: the grain, leaves, stalks, tassel and cob can all be used to produce a large variety of food and non food products (Akobundu and Agyakwa, 1987).

Globally maize occupies an area of 174.2 m ha with the production of 852 m t and productivity accounts for 4890 kg ha^{-1}. In India, the maize is cultivated in occupies an area of 9.42 m ha with the production of 22.26 m t and average productivity of 2583 kg ha^{-1}. In Karnataka maize occupies an area of 1.38 m ha, with the production of 4.00 m t and average productivity is 2883 kg ha^{-1} (Anon., 2014).

In India new leaf spot disease of maize incited by *Curvularia clavata* Jain has been reported from Varanasi region (Mandokhot and Basu Chaudhary, 1972). It was reported to cause a yield loss up to 60 per cent under inoculated conditions (Grewal and Payak, 1976). The disease incidence was recorded from four places in Uttarakhand. It was recorded in severe condition from Haridwar and Dehradun whereas from Kashipur and Haldwani it was recorded in moderate to traces. Extensive survey conducted in Rajasthan during *kharif* 2010 reveald that the incidence of *C. lunata* was in severe to moderate in villages like Lohira, Kavita, Iswal, Ghiyara and Baswara. Disease incidence was high in Rajasthan area due to high rain fall and high humidity (Anon., 2011). Keeping this in view experiment was desigened to Evaluation of spray schedule involving fungicide, commercially available botanical and ITK on Curvularia leaf spot of maize for yield and quality parameters

MATERIALS AND METHOD

Field experiment was laid out in a randomized block design with three replications at Agricultural Research Station (ARS), Arabhavi, University of Agricultural Sciences, Dharwad, during *kharif* 2014. The economically viable and effective fungicide, botanical and ITK under *in vitro* evaluation were tested under field condition using the Curvularia leaf spot susceptible maize genotype, CP 818. The integration of fungicide, botanical and ITK were

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evaluated with the spraying schedule given below Table No. 1.

Table 1. Details of treatments

Treatments	Spray schedule	
	1st Spray	2nd Spray
T1	PBP	PBP
T2	ITK	ITK
T3	F1	F1
T4	F2	F2
T5	F1	PBP
T6	F2	PBP
T7	F1	ITK
T8	F2	ITK
T9	Unsprayed control	

PBP: Plant based product, ITK: Indigenous Technology Knowledge and F: Fungicide

Recommended package of practices was followed to raise the crop. The inoculum of *C. lunata* was sprayed uniformly on all the treatments 30 days after sowing to create high disease pressure. Two sprays were given in each treatment at 15 days interval starting from the onset of disease. Observations on disease severity were taken at physiological maturity by following 0 to 9 scale of Mayee and Datar (1986). Grain yield per plot and 100 grain weight were noted down after the harvest of the crop. Harvested grains from individual treatments were subjected for starch and oil estimation.

The severity of Curvularia leaf spot disease was recorded by using 0 - 9 scale of Mayee and Datar (1986).

Scale:

Rating value	Description
0	No symptoms on the leaf.
1	Up to 1% of leaf area covered with leaf spots
3	1-10% of leaf area covered with leaf spots.
5	11-25% of leaf area covered with leaf spots.
7	26-50% of leaf area covered with leaf spots
9	More than 50% of leaf area covered with leaf spots

Further, these scales were converted to per cent disease index (PDI) using the formula given by Wheeler (1969).

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of leaves assessed} \times \text{Maximum grade}} \times 100$$

RESULTS AND DISCUSSION

Effect of spray schedule on grain yield, 100 grain weight and stover yield

The spray schedule hexaconzole @ 0.1 per cent - hexaconazole @ 0.1 per cent (T_3) recorded significantly the highest grain yield of 79.58 q ha^{-1} over other spray schedule. Next best spray schedule was carbendazim + mancozeb @ 0.2 per cent - wanis @0. 5 per cent (T_6) which has recorded 67.08 q ha^{-1} and it was on par with spray schedule hexaconazole @ 0.1 per cent - wanis @ 0.5 per cent (T_5, 66.01 q ha^{-1}) and carbendazim + mancozeb @ 0.2 per cent- carbendazim + mancozeb @ 0.2 per cent (T_4, 64.90 q ha^{-1}). Grain yields in the spray schedule hexaconzole @ 0.1 per cent - panchagavya @ 10 per cent(T_7, 61.67 q ha^{-1}), carbendazim + mancozeb @ 0.2 per cent - panchagavya @ 10 per cent (T_8, 59.97 q ha^{-1}) and wanis @ 0.5 per cent- wanis @ 0.5per cent (T_1, 57.47 q ha^{-1}) were on par with each other. Significantly the lowest grain yield of 52.08 q ha^{-1} was recorded in unsprayed control (T_9).

Highest per cent increase in grain yield over unsprayed control was recorded in the spray schedule hexaconzole @ 0.1 per cent - hexaconazole @ 0.1 per cent (52.80) followed by carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5 per cent (28.80), hexaconazole @ 0.1 per cent - wanis @ 0.5 per cent (26.74), and carbendazim + mancozeb @ 0.2 per cent- carbendazim + mancozeb @ 0.2 per cent (24.61). Least per cent increase in grain yield over unsprayed control was observed in spray schedule wanis @0.5per cent- wanis @0.5 per cent (10.34).

Almost similar trend was observed with respect to 100 grain weight. Hexaconazole@ 0.1per cent - hexaconazole @ 0.1 per cent (T_3) recorded highest grain weight of 41.33 g and followed by hexaconzole @ 0.1 per cent - wanis @ 0.5 per cent (T_5, 40.00 g) , carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5per cent (T_6, 39.66 g), carbendazim + mancozeb @ 0.2 per cent- carbendazim + mancozeb @ 0.2 per cent (T_4, 38.66 g) followed by hexaconzole @ 0.1 per cent - panchagavya @ 10 per cent (T_7, 38.00 g) and were on par with each other. Least 100 grain weight of 35.00 g was recorded in unsprayed control.

Highest per cent increase in 100 grain weight over unsprayed control was recorded in the spray schedule hexaconazole @ 0.1 per cent - hexaconazole @ 0.1 per cent (18.08) and least was in panchagavya @ 10 per cent- panchagavya @ 10per cent (4.00).

The spray schedule hexaconazole @ 0.1 per cent - hexaconazole @ 0.1 per cent (T_3) recorded highest stover yield of 8.02 t ha^{-1} over other spray schedule. Next best spray schedule was hexaconazole @ 0.1 per cent- wanis @ 0.5per cent (T_5, 7.92 t ha^{-1}) which is on par with the spray schedule carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5per cent (T_6, 7.38 t ha^{-1}). Significantly the lowest stover yield of 6.30 t ha^{-1} was recorded in unsprayed control (T_9).

Highest per cent increase in stover yield over unsprayed control was recorded in the spray schedule hexaconazole @ 0.1 per cent - hexaconazole @ 0.1 per cent (27.30) and least was in Panchagavya @ 10 per cent- Panchagavya @ 10 per cent (3.96). The fungicidal spectrum of neem (*A. indica*) has already been investigated by Singh and Pande (1966) and reviewed in detail by Parveen and Alam (1993). Antifungal properties of *A. indica* were also established by Singh *et al.* (1984) and Usman *et al.* (1991). The chemical basis of this antifungal activity has been attributed to the presence of oil in the plant parts of *A. indica* (Singh and Dwivedi, 1990).

Benefit: Cost ratio

The benefit cost ratio has been worked out for different spray schedule and presented in Table 3. The highest B: C was obtained with spray schedule hexaconazole @ 0.1 per cent - hexaconzole @ 0.1 per cent (1:3.81) followed by hexaconazole @ 0.1 per cent - wanis @ 0.5 per cent and carbendazim + mancozeb @ 0.2 per cent - wanis @ 0.5per cent both were recorded B:C (1:2.81). Most of the remaining spray schedules treatments, T_4, T_7, and T_2 recorded next highest B: C of 1: 2.71, 1:2.69, 1: 2.43 and 1: 2.42, respectively. Least B: C of 1:2.18 was recorded in unsprayed control.

Effect of spray schedule on starch and oil content

The difference in both oil and starch content in the grains in different spray schedule was non significant (Table.3). However , numerically the spray schedule hexaconazole @ 0.1 per cent - hexaconzole @ 0.1 per cent (T_3) recorded highest oil content of 4.83per cent and it was 14.18 per cent more over the unsprayed control. Similar trend was also observed with respect to starch content where in the spray schedule hexaconazole@ 0.1 per cent - hexaconzole @ 0.1 per cent (T_3) recorded highest starch content of 70.97per cent which is 1.19 per cent more over the unsprayed control.

Table 2. Evaluation of spray schedule involving fungicide, commercially available botanical and ITK on Curvularia leaf spot of maize

Spray schedule	Percent Disease Index (PDI)	Grain yield (q/ha)	Per cent increase in grain yield over unsprayed control	100 grain weight (g)	Per cent increase in 100 grain weight over unsprayed control	Stover yield (t/ha)	Per cent increase in Stover yield over unsprayed control	B:C ratio
T_1: Wanis @ 0.5%- Wanis @ 0.5%	62.54 (52.26)*	57.47	10.34	37.33	6.65	7.00	11.11	2.40
T_2: Panchagavya @ 10%- Panchagavya @ 10%	68.66 (55.96)	60.42	16.01	36.40	4.00	6.55	3.96	2.43
T_3: Hexaconazole @0.1%- Hexaconazole @ 0.1%	42.35 (40.60)	79.58	52.80	41.33	18.08	8.02	27.30	3.81
T_4: Carbendazim + mancozeb @ 0.2%- Carbendazim + mancozeb @ 0.2%	56.02 (48.46)	64.90	24.61	38.66	10.45	7.08	12.38	2.71
T_5: Hexaconazole@0.1%- Wanis @ 0.5%	53.15 (46.80)	66.01	26.74	40.00	14.28	7.92	25.71	2.81
T_6: Carbendazim + mancozeb @ 0.2%- Wanis @ 0.5%	55.33 (48.06)	67.08	28.80	39.66	13.31	7.38	17.14	2.81
T_7: Hexaconazole @ 0.1%- Panchagavya @ 10%	61.40 (51.59)	61.67	18.41	38.00	8.57	7.05	11.90	2.69
T_8: Carbendazim + mancozeb @ 0.2%- Panchagavya @10%	65.72 (54.16)	59.97	15.14	37.17	6.60	6.67	5.87	2.42
T_9: Unsprayed control	75.91 (60.61)	52.08	-	35.00		6.30	-	2.18
S.Em±	**3.03**	**1.22**		**1.18**		**0.215**		
C.D. at 5 %	**9.11**	**3.65**		**3.54**		**0.644**		

* Arc sine transformed values.

Cost of grain Rs.1240/q, cost of Stover Rs.660/t , cost of fungicide/plant based products in Rs.Kg or l- hexaconazole(580), carbendazim + mancozeb(600), wanis(450) and panchagavya (Rs.1500/ha). Quantity

of spray solution used for two sprays per hectare Rs – 1250l. Cost of cultivation Rs.-20000/ha

Table 3. Effect of spray schedule on starch and oil content in grains as influenced by Curvularia leaf spot of maize

Spray schedule	Percent Disease Index (PDI)	Percent oil content in grains	Per cent increase in oil content over unsprayed control	Percent starch content in grains	Per cent increase in starch content over unsprayed control
T_1: Wanis @ 0.5%- Wanis @ 0.5%	62.54 (52.26)*	4.53 (12.29)	7.09	70.70 (57.23)	0.81
T_2: Panchagavya @ 10%- Panchagavya @ 10%	68.66 (55.96)	4.47 (12.20)	5.67	70.63 (57.19)	0.71
T_3: Hexaconazole @0.1%- Hexaconazole @ 0.1%	42.35 (40.60)	4.83 (12.70)	14.18	70.97 (57.40)	1.19
T_4: Carbendazim + mancozeb @ 0.2%- Carbendazim + mancozeb @ 0.2%	56.02 (48.46)	4.47 (12.20)	5.67	70.80 (57.29)	0.95
T_5: Hexaconazole @ 0.1%- Wanis @ 0.5%	53.15 (46.80)	4.60 (12.38)	8.74	70.90 (57.35)	0.23
T_6: Carbendazim + mancozeb @ 0.2%- Wanis @ 0.5%	55.33 (48.06)	4.50 (12.25)	6.38	70.80 (57.29)	0.95
T_7: Hexaconazole @ 0.1%- Panchagavya @ 10%	61.40 (51.59)	4.30 (11.97)	1.65	70.67 (57.21)	0.76
T_8: Carbendazim + mancozeb @ 0.2%- Panchagavya @10%	65.72 (54.16)	4.37 (12.06)	3.30	70.67 (57.21)	0.76
T_9: Unsprayed control	75.91 (60.61)	4.23 (11.87)	-	70.13 (56.87)	-
S.Em±	**3.03**	**0.28**		**0.33**	
C.D. at 1 %	**9.11**	**NS**		**NS**	

* Arc sine transformed values

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