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ALTERNARIA AND CERCOSPORA LEAF SPOT DISEASES OF NIGER (*GUIZOTIA ABYSSINICA* CASS.) – A TRADITIONAL TRIBAL CROP OF SOUTH GUJARAT, INDIA, WITH COST BENEFIT RATIO IN RELATION TO DIFFERENT FUNGICIDES

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ABSTRACT. Niger (*Guizotia abyssinica* Cass.) is an important minor oil seed crop grown in dry areas grown mostly by tribal and interior places as life line of tribal segment. Tribal people mainly use its oil for cooking purpose, above than that there were also other uses. Hence, the niger crop should be protected from the infection. The crop is affected by number of fungal diseases. Therefore, a field experiment was formulated for three years with the four replications at the Niger Research Station (NRS) at Navsari Agricultural University (NAU), Vanarasi, Navsari (Gujarat) on the foliar diseases of GN-1 variety of niger crop. In this experiment, six different fungicides along with one control have been evaluated to control the Alternaria and Cercospora leaf spot diseases, out of which all the fungicidal treatments were significantly superior over the control. Here, foliar spray on the incidence of diseases was compared with the control (without any treatment). All the fungicidal treatments were significantly superior over the control to reduce Alternaria and Cercospora leaf spot diseases of Niger crop. Treatment of Carbendazim + Mancozeb (0.2 %) with two sprays first from the initiation of the disease and second after the interval of 15 days recorded the lowest incidence of Alternaria (14.56) and Cercospora (14.94) leaf spot diseases of niger and recorded the highest seed yield 337 seed yield kg/ha along with the net return with cost benefit ratio graph.

Keywords: niger*;* fungicide; Alternaria; Cercospora; cost benefit ratio; residue analysis.

INTRODUCTION

Niger (*Guizotia abyssinica* Cass.) is an important minor oil seed

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crop grown in countries like India, Ethiopia, East Africa, West Indies and Zimbabwe. In India, it is mainly cultivated in tribal pockets of Gujarat, M.P., Orissa, Maharashtra, Bihar, Karnataka and Andhara Pradesh. Niger is a crop of dry areas grown mostly by tribal and interior places as life line of tribal segment. Niger is commonly known as *ramtil*, *jagni* or *jatangi* (Hindi), *ramtal* (Gujarati), *karale* or *khurasani* (Marathi), *uhechellu* (Kannada), *payellu* (Tamil), *verrinuvvulu* (Telgu), *alashi* (Oriya), *sarguza* (Bengali), *ramtil* (Punjab) and *sorguja* (Assamese) in various parts of the country (Rao and Ranganatha, 1989). Niger is an important oilseed crop in Ethiopia, where it provides about 50-60% oil for domestic consumption (Riley and Belayneh, 1989). It is also used as oilseed crop in India, where it provides about 3% of the edible oil requirement of the country (Getinet and Sharma, 1996). The niger seed contains 33.3% protein, 34.2-39.7% total carbohydrates and 13.5% fiber. Niger oil is slow drying, so used in food, paint, soap and as an illuminant.

The oil is used as cooking, as a ghee substitute. The oil is used in cooking and also used to treat burns and in the treatment of scabies. The seed is eaten fried, used as condiments or dried, powdered and mixed with flour to make sweet cakes. The seeds are used in chutney preparation with curd. The press cake from oil extraction is used for livestock feed. The oil is considered good for health (Panday *et al*., 2014). The niger crop is found infested by number of diseases and pests, which causes harsh damage to the crop. Further, the accidental rain at flowering stage leads the expansion of Alternaria and Cercospora leaf spot incidence and results in the poor seed set and seed yield. The crop is affected by number of fungal diseases. The important diseases of niger are Alternaria blight (*Alternaria porii* & *A. alternata*), leaf spot (*Cercospora guizoticola*), seedling blight (*Alternaria tenuis*), seed rot (*Rhizoctonia bataticola*), rust (*Puccinia guizotiae*), powdery mildew (*Sphaerotheca* sp.), root rot (*Macrophomina phaseolina*) and cuscuta, as *Phanerogamic* parasite (Rajpurohit, 2004 and Rajpurohit and Dubal, 2009). Cercospora and Alternaria diseases cause heavy damage to this crop and reduce its seed yields, which harm the status of the farmers. Currently studies pertaining to the use of fungicides in management of diseases are highly emphasized (Kolte, 1985; Rajpurohit *et al*., 2005; Rajpurohit, 2011).

Looking on importance in terms of oil extraction, which having high medicinal values but knowledge of the diseases of this niger crop merits attention, niger is a crop of dry areas grown mostly by tribal in interior places, due to which desired attention has not been given on the biotic and abiotic stresses. Now, the crop is gaining importance and studies are being made on disease aspects (Rajpurohit, 2011). Among the fungicides quintal @ 2 g/l had given

significantly higher number of effective capitula per plant (47.02), number of filled seeds per capitula (15.37), seed yield per plant (3.59 g), 1000 seed weight (4.15 g), yield per ha (368 kg/ha) over control and was on par with other fungicides when niger was protected from leaf spot disease with the fungicidal spray, which recorded significantly higher values over unsprayed control (Kivadasannavar *et al*., 2007). Whereas, these yield components were decreased in unsprayed controlled condition (Gorbert *et al.,* 1982 and Indi *et al.,* 1986). Therefore, this study was planned to record the diseases of niger crop plant, so that preventive measures can be taken well in advance to avoid any crop damage. Keeping in view the destructive nature of the diseases and economic loss, the present investigation was undertaken to evaluate the efficacy of different fungicides under *in vivo* condition. Considering the economic losses in this present investigation attempts were therefore made to ascertain the spectrum of fungal diseases of niger crop.

MATERIAL AND METHODS

The experiment was laid out in RBD with the four replications at Niger Research Station (Vanarasi farm), Navsari Agricultural University (NAU), Navsari (Gujarat).

At the time of monsoon, the accidental rain at flowering and seed development stage leads to Alternaria and Cercospora leaf spot incidence and results in poor seed set and seed yield. In such cases, there is need to protect the crop through suitable fungicidal sprays at this stage.

Hence, keeping in view all above parameters and facts, the study on fungicidal application on crop growth in Niger was initiated. In this experiment below, six different treatments was incorporated along with the control.

1	**Crop and variety**		Niger, variety GN-1
2	**Treatments**	**:**	Seven treatments (07)
3	**Design**	**:**	R. B. D.
4	**Plot size**	**:**	Net : 3.0 x 2.4 m
5	**Spacing**	**:** **:**	30 cm between two rows 10 cm between plant to plant
6	**Replications**	**:**	4 (Four)
7	**Fertilizer** **Basal Dose** **Top Dressing**	**:** **:**	10:20:00 NPK/ha 10:00:00 NPK/ha
8	**Sowing dates**	**:**	2012-13 : 25.08.2012 2013-14 : 02.07.2013 2014-15 : 23.07.2014
9	**No of rows in Net plot**	**:**	8
10	**Crop Condition**	**:**	During all the three year season, the average rainfall was more than sufficient in the Niger crop. The plant population and crop growth was healthy.

			However, at the time of flowering the inhabitants of honeybees were found less in the number. They were seen late in the morning and disappeared early in the evening time which, effect on the seed yield of the Niger crop. Apart from this in 2014-15, there was less rainfall and at the harvesting phase crop suffered little bit stress of water.

Treatment details as follows: T_1 - Carbendazim 50 WP (0.1%); T_2 - Hexaconazole (0.1%); T_3 - Mancozeb (0.2%); T_4 - Propiconazole (0.1%); T_5 - Wettable Sulphur (0.2%); T_6 - Carbendazim + Mancozeb (0.2%); T_7 - Control.

Application of required dose of fungicides was sprayed at the initial appearance of the disease and second at the interval of 15 days. Observation on foliar disease infection was calculated on niger plant by observing top, middle and bottom leaves of the plant were chosen and scored as per the scale given below. Percent Disease Incidence (PDI) was recorded as per the disease intensity at field condition prior to spray and at the time of harvest by using Disease Rating scale of (0 to 5), as developed by Mayee and Datar (1986) and Townsend and Heuberger (1943) (*Table 1*).

Table 1 - Disease rating scale

Score	Description	Reaction
0	No infection	Immune
1	1-10 % lead area infected	Resistant
2	11-25 % lead area infected	Moderately resistant
3	26-50 % lead area infected	Moderately susceptible
4	51-70 % lead area infected	Susceptible
5	71-100 % lead area infected	Highly susceptible

The average intensity in each plot was calculated by the formula as employed by Wheeler, 1969.

$$PDI = \frac{\text{Summation of infected plants}}{\text{No. of leaves observed} \times \text{Max. disease score}} \times 100$$

RESULTS AND DISCUSSION

In this experiment, different fungicides have been evaluated to control the Alternaria disease, as the disease appears as concentric rings on the leaves, which turns brown with gray centre later on. The spots become oval or circular and become irregular in shape. The infected leaves become dry and lead to the defoliation (Yirgu, 1964). As far as Cercospora leaf spot disease is concerned it is more severe under warm and humid weather. Small straw colored to brownish spots are formed on both the leaf surfaces. Later, the spots are increase in number and size and cover the entire lamina and leaves start dropping off (Rajpurohit, 2011 and Sandipan *et al.*, 2014). Different

fungicides were evaluated to control the disease, out of which all the fungicidal treatment were significantly superior over control. The least incidence of Alternaria (19.08 PDI) and Cercospora leaf spot (19.18 PDI) was observed in T6 treatment containing Saaf (Carbendazim + Mancozeb, 0.2%), which was followed by the T1- Carbendazim 50 WP (0.1%) for both the diseases Alternaria (19.00 PDI) and Cercospora leaf spot (18.48 PDI), respectively, during all the three years and in pooled results (*Tabs. 2 and 3, Figs. 1 and 2*). With respect to seed yield, T6 - Saaf (0.2%) treatment recorded the highest seed yield (337 kg/ha) (*Table 5*), followed by T_4 - Propiconazole (0.1%) 308 kg/ha in the pooled results (*Table 4, Fig. 3*).

The present work was in agreement with the findings of Saharan *et al*. (2005), as two sprays of Zineb or Dithane M-45 at the rate of 0.3% manages Alternaria disease. Spraying Mancozeb @ 0.2% at 15 days interval reported effectively (Hedge, 2005). The diseased can also be effectively controlled by spraying SAAF at 0.2% at the initial appearance of the disease and second spray after the 10-15 days of interval to control the disease effectively (Sandipan *et al.,* 2014). There is also no residual effect of these fungicides to the niger crop, as shown in *Table 6*.

A) Cercospora; B) Alternaria with Cercospora

Table 2 - Efficacy of foliar sprays on incidence of Alternaria leaf spot (*Alternaria* sp.) disease of Niger

Sr. No.	Treatment	Dose (%)	Mean PDI			Pooled
			2012	2013	2014	
T-1	Carbendazim 50 WP	(0.1)	17.32 (24.53)	17.66 (24.83)	21.66 (27.37)	19.00 (25.77)
T-2	Hexaconazole 5% SC	(0.1)	20.27 (26.74)	19.83 (26.42)	22.99 (28.63)	21.08 (27.30)
T-3	Mancozeb 75 WP	(0.2)	24.41 (29.59)	25.66 (30.42)	24.33 (29.53)	24.80 (29.85)

T-4	Propiconazole 25% EC	(0.1)	20.98 (27.24)	21.66 (27.72)	19.33 (26.06)	20.90 (27.18)
T-5	Wettable Sulphur 80 WP	(0.2)	30.48 (33.49)	33.83 (35.54)	31.33 (34.01)	31.81 (34.31)
T-6	**Carbendazim + Mancozeb 75 WP**	**(0.2)**	**14.41 (22.39)**	**13.66 (21.67)**	**15.16 (22.86)**	**14.56 (22.41)**
T-7	Control		41.75 (40.23)	40.33 (39.40)	39.16 (38.72)	44.63 (41.88)
SEm ±			**0.47**	**0.23**	**0.46**	**0.40**
CD at 5 %			**1.40**	**0.69**	**1.38**	**1.20**
CV %			**3.25**	**1.58**	**3.16**	**2.77**
Y x T						*****
SEm ±						**0.40**
CD at 5 %						**1.20**

Figures in the parentheses are arcsine transformed values.

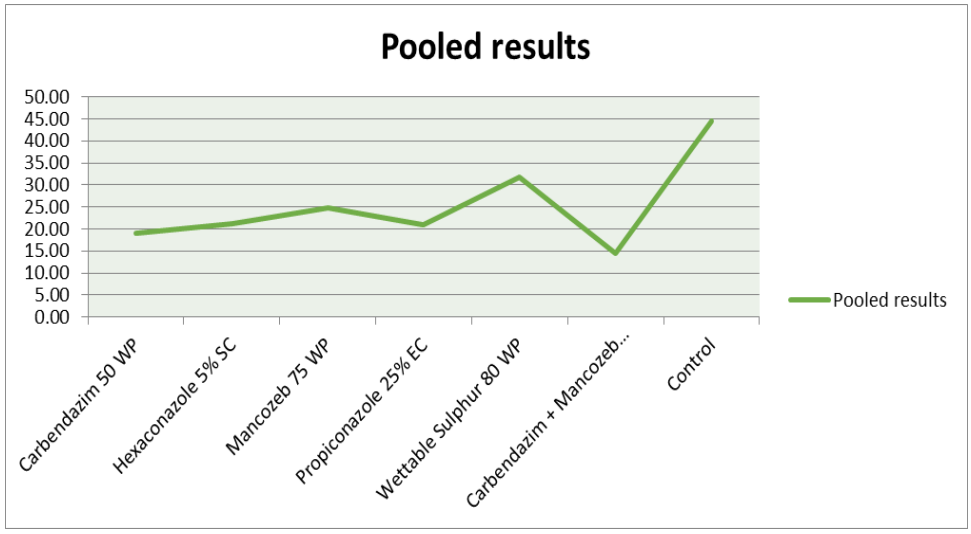

Figure 1 - Infection graph for Alternaria disease

Table 3 - Efficacy of foliar sprays on incidence of Cercospora leaf spot (*Cercospora guizoticola*) disease of niger

Sr. No.	Treatment	Dose (%)	Mean PDI			Pooled
			2012	2013	2014	
T-1	Carbendazim 50 WP	(0.1)	17.03 (24.36)	19.66 (26.30)	19.49 (26.17)	18.48 (25.43)
T-2	Hexaconazole 5% SC	(0.1)	22.52 (28.31)	23.66 (29.09)	24.82 (29.86)	23.36 (28.88)
T-3	Mancozeb 75 WP	(0.2)	24.36 (29.56)	27.66 (31.71)	22.33 (28.17)	24.99 (29.96)

T-4	Propiconazole 25% EC	(0.1)	23.71 (29.12)	24.33 (29.54)	18.83 (25.69)	22.55 (28.30)
T-5	Wettable Sulphur 80 WP	(0.2)	32.03 (34.45)	34.33 (35.85)	28.66 (32.34)	31.25 (33.96)
T-6	**Carbendazim + Mancozeb 75 WP**	**(0.2)**	**13.62 (21.64)**	**15.49 (23.17)**	**16.66 (24.06)**	**14.94 (22.71)**
T-7	Control		44.60 (41.62)	44.33 (41.72)	37.99 (37.64)	43.05 (40.81)
SEm ±			**0.28**	**0.28**	**0.46**	**0.35**
CD at 5 %			**0.85**	**0.84**	**1.39**	**1.06**
CV %			**1.92**	**1.83**	**3.22**	**2.38**
Y x T						*
SEm ±						**0.35**
CD at 5 %						**1.06**

Figures in the parentheses are arcsine transformed values.

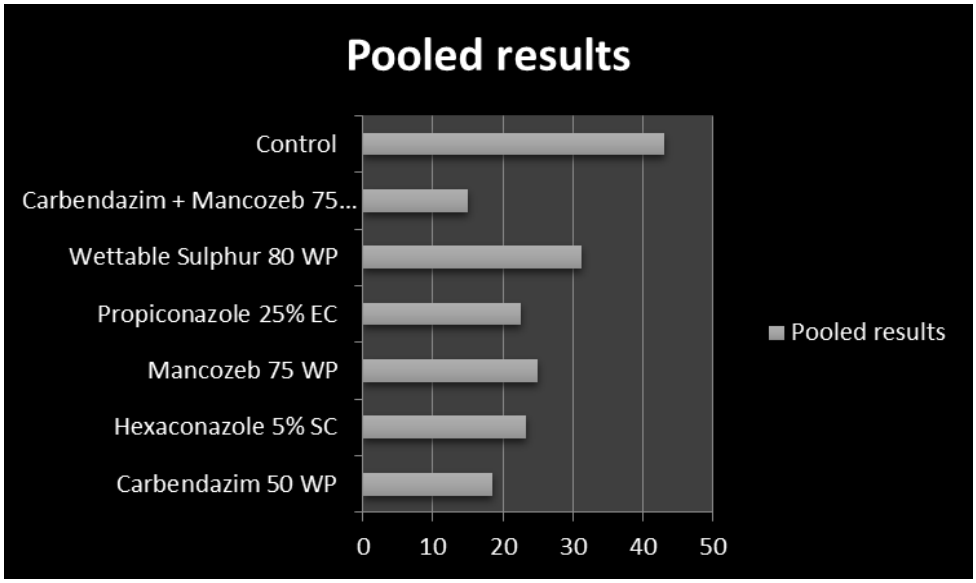

Figure 2 - Infection graph for Cercospora disease

Table 4 - Effect on seed yield of niger crop

Sr. No.	Treatment	Mean Seed Yield (Kg/ha)			Pooled
		2012	2013	2014	
T-1	Carbendazim 50 WP	305	370	221	299
T-2	Hexaconazole 5 % SC	312	365	240	305
T-3	Mancozeb 75 WP	298	349	231	293
T-4	Propiconazole 25 % EC	307	369	247	308
T-5	Wettable Sulphur 80 WP	280	355	237	291

T-6	**Carbendazim + Mancozeb 75 WP**	**287**	**401**	**323**	**337**
T-7	Control	263	294	161	239
SEm ±		**16.68**	**19.80**	**11.87**	**16.41**
CD at 5 %		**-**	**55.84**	**35.28**	**46.56**
CV %		**11.32**	**11.08**	**10.02**	**11.10**
Y X T					*

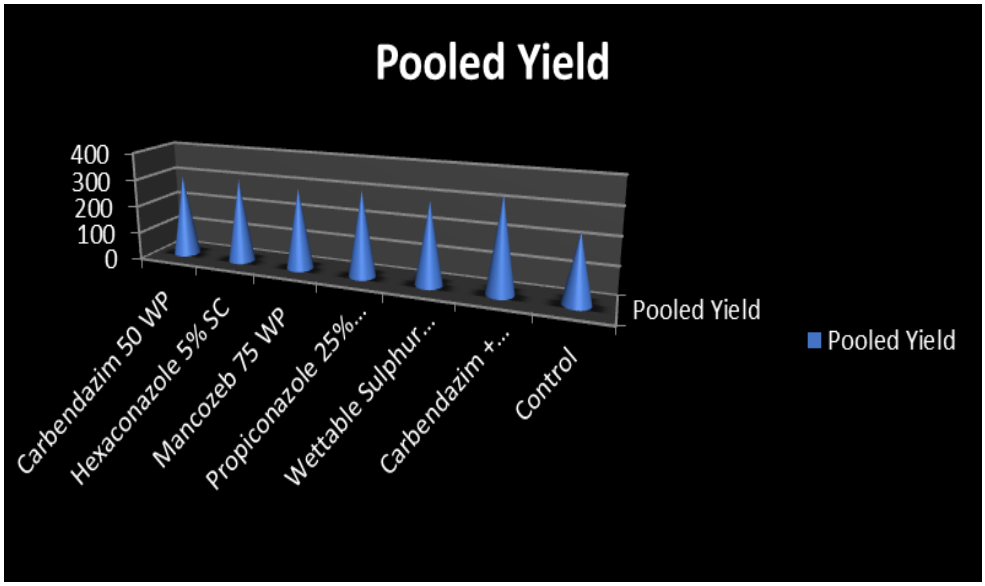

Figure 3 - Yield analysis graph for the three years pooled result

Economics

Detailed cost of fungicides/seed:

- average cost of niger seed @ Rs. 60/kg
- Cost of Niger cultivation @ Rs. 7038/-
- Cost of Carbendazim for two sprays Rs. 1140/-
- Cost of Hexaconazole for two sprays Rs. 312/-
- Cost of Mancozeb for two sprays Rs. 1011/-
- Cost of Propiconazole for two sprays Rs. 864/-
- Cost of Wettable Sulphur for two sprays Rs. 153/-
- Cost of Carbendazim + Mancozeb fungicides for two sprays Rs. 944/-
- Cost of spray operations Rs.400/- Cost of labour Rs.150/day.

Table 5 - Economics of different fungicidal treatments

Sr. No.	Treatments	Pooled mean Yield (kg/ha)	Quantity of fungicides/ spray/ha	Cost of fungi-cide (Rs./ ha)	Cost of fungi-cide for two spray (Rs./ ha)	Appli-cation cost of fungi-cide for two spray (Rs./ha)	Total cost of plant protec tion for two spray (Rs./ ha)	GMR	NMR	BCR Gross	BCR Net
1	Carbendazim 50 WP	299	600	570	1140	400	1540	17940	9362	2.09	1.09
2	Hexaconazole 5% SC	305	300	156	312	400	712	18300	10550	2.36	1.36
3	Mancozeb 75 WP	293	800	506	1012	400	1412	17580	9130	2.08	1.08
4	Propiconazole 25% EC	308	300	432	864	400	1264	18480	10178	2.23	1.23
5	Wettable Sulphur 80 WP	291	750	77	154	400	554	17460	9868	2.30	1.30
6	**Carbendazim + Mancozeb 75 WP**	**337**	**800**	**472**	**944**	**400**	**1344**	**20220**	**11838**	**2.41**	**1.41**
7	Control	239	-	-	-	-	-	14340	7302	2.04	1.04

Table 6 - Recommendation of PHI as per CIB guidelines

Year	Crop	Pest/ disease	Pesticides with formulation	Dosage				Application schedule	Waiting period/PHI (days)	Remark
				G a.i. /ha	Quantity of formulation /ha	Conc. (%)	Dilution in water (10 L)			
2014	Niger	Alternaria and Cercospora leaf spot	Carbendazim 12% WP and Mancozeb 63% WP	600 g/ha	800 g/ha	0.2	20 g	Spraying at disease initiation and after 15 days	50	-

Fungicidal residual analysis report

Sr. No.	Sample ID	Results (ug g^{-1})
1	Carbendazim	0.018
2	Mancozeb	BDL

BDL - below determination limit

Reference taken from the www.codexalimentarious.org for the Carbendazim MRL value, as the MRL valve for niger seed is not available. So, cross reference has been taken. Minimum - 0.02 mg/kg and maximum - 15 mg/kg for all the crops in the above website except niger crop. So, our Carbendazim MRL valve is below than the minimum said valve.

Cross references: mustard seed - Carbendazim MRL value - 0.05 mg/kg; soya bean - Carbendazim MRL value - 0.5 mg/kg.

CONCLUSION

Seed treatment with Carbendazim @ 1 h/kg + Mancozeb @ 2g/kg along with their two sprays at 30 and 45 DAS were found effective for the management of niger foliar diseases Alternaria and Cercospora with 35% higher seed yield.

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