

Disease scoring in Maize (*Zea mays* L.) - Soybean (*Glycine max* L.) Sequence Cropping Under Conservation Agriculture Principles and Practices

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ABSTRACT

Experiment were conducted in Maize (*Zea mays* L.) – Soybean (*Glycine max* L.) during 2012-13 and 2013-14 at Dharwad under split split plot design with irrigation levels in main plots and fertilizer levels and its application in sub plots. Alternatively alternate furrow irrigation, fertilizer levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25), application as 33 per cent each (1/3rd) of N, P₂O₅ and K₂O as basal, 33 per cent each of N, P₂O₅ and K₂O at 30 DAS and 33 per cent each of N, P₂O₅ and K₂O at 50 DAS and its interaction recorded significantly higher occurrence of Turcicum leaf blight diseases in Maize. Besides, residual effect of alternatively alternate furrow irrigation, fertilizer levels of 225:100:100 kg N:P₂O₅:K₂O ha⁻¹ (2.25:1:1), fertilizer applications as 25 per cent (1/4th) of N, K₂O and 50 per cent of P₂O₅ as basal, 50 per cent of N, P₂O₅ and K₂O at 30 DAS and 25 per cent of N and K₂O at 50 DAS and its interaction documented significantly higher rust diseases in Soybean.

Keywords: Alternatively alternate furrow irrigation, Fertilizer levels, Application of fertilizers and Residual effect.

INTRODUCTION

Maize an important staple food crop affected by number of diseases during its growth stages, besides, turcicum leaf blight (*Exserohilum turcicum*) is one of the most important diseases with 98 per cent losses in Karnataka. Soybean rust incited by *Phakopsora pachyrhizi* is one of the most serious disease inflicting quantitative as well as qualitative losses. The disease is more

severe under assured rainfall and irrigated conditions with moderate temperatures and extended leaf wetness. With the introduction of high yielding genotypes, extensive use of fertilizer, traditional irrigation management practices and continuous cropping system, there has been a phenomenal increase in incidence of diseases in various cropping system.

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Besides, conservation agriculture principles and practices *i.e.* minimum and zero tillage, use of preceding crop residues to protect soil and water in succeeding crops and cropping system *i.e.* Cereal – Legume sequence cropping lead to further variation in diseases. Hence, present study was conducted to know the occurrence of diseases under the prevailing conditions.

MATERIALS AND METHODS

Investigations were carried out in Maize (*Zea mays* L.) – Soybean (*Glycine max* L.) at Main Agricultural Research Station, Dharwad on clayey soil. Initial soil sampling of experimental plot recorded pH (7.4), EC (0.23 dS/m), organic carbon (0.55), available N (250 kg ha⁻¹), available P₂O₅ (33 kg ha⁻¹), available K₂O (290 kg ha⁻¹), exchangeable Ca (28 cmol (p+) kg⁻¹), exchangeable Mg (7 cmol (p+) kg⁻¹) and available S (21 kg ha⁻¹). Maize were evaluated with irrigation and fertilizer management practices under minimum tillage during summer (2012-13 and 2013-14), followed by Soybean as residual crop under zero tillage in *Kharif* season (2013-14 and 2014-15). Experiment was laid out in split split plot design with irrigation levels in main plots, fertilizer levels and its application rate in sub plots with three replications. Irrigation levels were deficit irrigation at growth stages (I₁), I₁ + hydrogel with 2.5 kg ha⁻¹ (I₂) and alternatively alternate furrow irrigation at 50 per cent depletion of soil moisture (I₃). Fertilizer levels were as F₁ - 200:75:75 kg N:P₂O₅:K₂O ha⁻¹ (2.67:1:1), F₂ - 225:100:100 kg N:P₂O₅:K₂O ha⁻¹ (2.25:1:1) and F₃ - 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25). Fertilizer applications were T₁ - 25 per cent (1/4th) of N, K₂O and 50 per cent of P₂O₅ as basal, 50 per cent of N, P₂O₅ and K₂O at 30 DAS and 25 per cent of N and K₂O at 50 DAS and T₂ - 33 per cent each (1/3rd) of N, P₂O₅ and K₂O as basal, 33 per cent each of N, P₂O₅ and K₂O at 30 DAS and 33 per cent each of N, P₂O₅ and K₂O at 50 DAS in sub plots. Besides, control outside the design *i.e.*, Conventional furrow irrigation and fertilizer levels of 150:75:37.5 kg N:P₂O₅:K₂O ha⁻¹ (4:2:1) and its

applications as 15 kg N plus full dose of P₂O₅ and K₂O as basal, 30 kg N at 20 DAS, 45 kg N each at 35 and 50 DAS and 15 kg N at 65 DAS). MgSO₄ (10 kg ha⁻¹) and gypsum (250 kg ha⁻¹) were amended for all treatments, except control and data were analyzed as per Gomez and Gomez (1984). Five Maize plants were randomly selected for recording the diseases severity based on 1 to 5 rating scale (Laxminarayan and Shankarlingam, 1983). Further, Per cent Disease Index was calculated as per Payak and Sharma (1983) and transformed to reduced the variation. Besides, the trifoliolate soybean leaves from middle portion of the plants were randomly collected and assessed for rust severity using 0 to 9 scales of Mayee and Datar (1986) and Per cent Disease Index was calculated by using the formula of Wheeler (1969), further data was transformed for analysis.

RESULTS AND DISCUSSION

Turcicum leaf blight in Maize

Effect of irrigation and fertilizer management practices differed significantly at 60 and 90 days after sowing on turcicum leaf blight (Table 1). Alternatively alternate furrow irrigation, fertilizer levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25), scheduling of fertilizers as 33 per cent each (1/3rd) of N, P₂O₅ and K₂O as basal, 33 per cent each of N, P₂O₅ and K₂O at 30 DAS and 33 per cent each of N, P₂O₅ and K₂O at 50 DAS and its interaction recorded higher severity of diseases (27.91, 27.55, 27.77 and 30.57 per cent, respectively) at 90 days after sowing when compared to other treatment combinations. Similar trend were recorded at 60 days after sowing. Scheduling alternatively with higher depth of irrigation and higher nutrients with staggered application during crop growth period changed micro climate of maize crop in lower layers, higher temperature during summer, higher relative humidity, along with occasionally higher rainfall favored higher incidence and multiplication of diseases from lower leaves to upper leaves. Besides control recorded diseases severity of 26.58 per cent at 60 and 90 days after sowing. Similar research findings

were also recorded by Chandrashekara et al. (2014), Dalavai and Kalappanavar (2017), and Patil and Motagi (2020).

Leaf rust in Soybean

Residual effect of irrigation and fertilizer management practices on leaf rust differed significantly at 45 days after sowing and harvest (Table 1). residual effect of alternatively alternate furrow irrigation, fertilizer levels of 225:100:100 kg N:P₂O₅:K₂O ha⁻¹ (2.25:1:1), fertilizer applications as 25 per cent (1/4th) of N, K₂O and 50 per cent of P₂O₅ as basal, 50 per cent of N, P₂O₅ and K₂O at 30 DAS and 25 per cent of N and K₂O at 50 DAS and its interaction observed significantly higher severity of diseases (3.25, 2.26, 3.17

and 9.26 per cent, respectively) at harvest when compared to other treatments. Similar results were recorded at 45 days after sowing. Delayed sowing, high weed intensity under zero tillage, left over maize residues, fallow knock down weeds after maize, high relative humidity, optimum temperature and intermittent rainfall in early stage favored uredospore germination. Whereas, low humidity, high temperature and high rainfall in later stage of crop favored higher multiplication of rust. Further, control plot there was no disease incidences. Similar research findings were also recorded by Sarnobat et al. (2019), Shamarao Jahagirdar (2019) and Sharadha et al. (2020).

Table 1: Turicum leaf blight of Maize and Soybean rust (pooled data) at different growth stages as influenced by irrigation and fertilizer management practices

I	Diseases	Turicum leaf blight of Maize						Soybean rust					
	Stage	60 DAS			90 DAS			45 DAS			Harvest		
		T ₁	T ₂	I × F	T ₁	T ₂	I × F	T ₁	T ₂	I × F	T ₁	T ₂	I × F
		I × F × T		I × F	I × F × T		I × F	I × F × T		F	I × F × T		F
I ₁	F ₁	26.58c *	26.58c	26.58b	26.58b	26.58b	26.58b	1.43b	0.00b	0.71b	4.32ab	2.03ab	3.18a
		(20.00) **	(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(0.37)	(0.00)	(0.19)	(1.85)	(0.74)	(1.30)
	F ₂	26.58c	27.04bc	26.81ab	26.58b	27.48b	27.03ab	0.00b	0.00b	0.00b	2.86ab	1.43ab	2.14a
	(20.00)	(20.67)	(20.33)	(20.00)	(21.33)	(20.67)	(0.00)	(0.00)	(0.00)	(0.74)	(0.37)	(0.56)	
	F ₃	26.58c	28.37a	27.48a	26.58b	27.48b	27.03ab	0.00b	0.00b	0.00b	0.00b	0.00b	0.00a
	(20.00)	(22.67)	(21.33)	(20.00)	(21.33)	(20.67)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
I ₂	F ₁	26.58c	26.58c	26.58b	26.58b	26.58b	26.58b	1.43b	0.00b	0.71b	6.35ab	3.25ab	4.80a
		(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(0.37)	(0.00)	(0.19)	(2.59)	(1.85)	(2.22)
	F ₂	26.58c	26.58c	26.58b	27.04b	27.04b	27.04ab	0.00b	0.00b	0.00b	0.00b	0.00b	0.00a
	(20.00)	(20.00)	(20.00)	(20.67)	(20.67)	(20.67)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
	F ₃	26.58c	27.48a-c	27.03ab	27.04b	27.04b	27.04ab	0.00b	0.00b	0.00b	0.00b	0.00b	0.00a
	(20.00)	(21.33)	(20.67)	(20.67)	(20.67)	(20.67)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
I ₃	F ₁	26.58c	26.58c	26.58b	26.58b	26.58b	26.58b	5.95a	3.46ab	4.71a	5.74ab	4.52ab	5.13a
		(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(2.22)	(1.11)	(1.67)	(2.96)	(1.85)	(2.41)
	F ₂	26.58c	27.94ab	27.26ab	26.58b	30.57a	28.57a	2.86ab	0.00b	1.43b	9.26a	0.00b	4.63a
	(20.00)	(22.00)	(21.00)	(20.00)	(26.00)	(23.00)	(0.74)	(0.00)	(0.37)	(5.19)	(0.00)	(2.59)	
	F ₃	26.58c	27.04bc	26.81ab	26.58b	30.57a	28.57a	1.43b	0.00b	0.71b	0.00b	0.00b	0.00a
	(20.00)	(20.67)	(20.33)	(20.00)	(26.00)	(23.00)	(0.37)	(0.00)	(0.19)	(0.00)	(0.00)	(0.00)	
I ₄		T ₁	T ₂	I	T ₁	T ₂	I	T ₁	T ₂	I	T ₁	T ₂	I
		I × T		I	I × T		I	I × T		I	I × T		I
	I ₁	26.58b	27.33a	26.95a	26.58b	27.18b	26.88b	0.48b	0.00b	0.24b	2.39a	1.15a	1.77b
		(20.00)	(21.11)	(20.56)	(20.00)	(20.89)	(20.44)	(0.12)	(0.00)	(0.06)	(0.86)	(0.37)	(0.62)
	I ₂	26.58b	26.88b	26.73a	26.89b	26.89b	26.89b	0.48b	0.00b	0.24b	2.12a	1.08a	1.60b
	(20.00)	(20.44)	(20.22)	(20.44)	(20.44)	(20.44)	(0.12)	(0.00)	(0.06)	(0.86)	(0.62)	(0.74)	
	I ₃	26.58b	27.19ab	26.88a	26.58b	29.24a	27.91a	3.41a	1.15b	2.28a	5.00a	1.51a	3.25a
	(20.00)	(20.89)	(20.44)	(20.00)	(24.00)	(22.00)	(1.11)	(0.37)	(0.74)	(2.72)	(0.62)	(1.67)	
I ₅		T ₁	T ₂	F	T ₁	T ₂	F	T ₁	T ₂	F	T ₁	T ₂	F
		F × T		F	F × T		F	F × T		F	F × T		F
	F ₁	26.58b	26.58b	26.58b	26.58b	26.58b	26.58b	2.94a	1.15ab	2.05a	5.47a	3.27ab	4.37a
		(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(20.00)	(0.99)	(0.37)	(0.68)	(2.47)	(1.48)	(1.98)
	F ₂	26.58b	27.19ab	26.88ab	26.73b	28.36a	27.55a	0.95ab	0.00b	0.48b	4.04ab	0.48b	2.26ab
	(20.00)	(20.89)	(20.44)	(20.22)	(22.67)	(21.44)	(0.25)	(0.00)	(0.12)	(1.98)	(0.12)	(1.05)	
	F ₃	26.58b	27.63a	27.10a	26.73b	28.36a	27.55a	0.48b	0.00b	0.24b	0.00b	0.00b	0.00b
	(20.00)	(21.56)	(20.78)	(20.22)	(22.67)	(21.44)	(0.12)	(0.00)	(0.06)	(0.00)	(0.00)	(0.00)	
	T	26.58b	27.13a		26.68b	27.77a		1.46a	0.38b		3.17a	1.25b	
	(20.00)	(20.81)		(20.15)	(21.78)		(0.45)	(0.12)		(1.48)	(0.53)		
	Control	26.58 (20.00)			26.58 (20.00)			0.00 (0.00)			0.00 (0.00)		
	Comp. of means	S.Em.±			S.Em.±			S.Em.±			S.Em.±		
	I	0.20			0.13			0.29			0.30		
	F	0.32			0.16			0.54			1.01		

T	0.26	0.13	0.44	0.83
I × F	0.55	0.27	0.93	1.76
I × T	0.45	0.22	0.76	1.43
F × T	0.45	0.22	0.76	1.43
I × F × T	0.78	0.39	1.32	2.49
Treat. v/s control	0.73	0.37	1.23	2.28

Irrigation levels (I) :

I₁ - Deficit irrigation (growth stages)

Fertilizer levels (F) :

F₁ - 200:75:75 kg
N:P₂O₅:K₂O ha⁻¹ (2.67:1:1)

Time of application (T) :

T₁ – 25 per cent of N, K₂O and 50 per cent of P₂O₅ as basal,
T₂ – 33.3 per cent each of N, P₂O₅ and K₂O as basal,

I₂ - I₁ + hydrogel (2.5 kg ha⁻¹)

F₂ - 225:100:100 kg
N:P₂O₅:K₂O ha⁻¹ (2.25:1:1)

50 per cent of N, P₂O₅ and K₂O at 30 DAS and
33.3 per cent each of N, P₂O₅ and K₂O at 30 DAS and

I₃ - Alternatively alternate furrow irrigation (50 % depletion of soil moisture)

F₃ - 250:100:125 kg
N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25)

25 per cent of N and K₂O at 50 DAS
33.3 per cent each of N, P₂O₅ and K₂O at 50 DAS

Control : Conventional furrow irrigation with 150:75:37.5 kg N:P₂O₅:K₂O ha⁻¹ (4:2:1) scheduled as 15 kg N plus full dose of P₂O₅ and K₂O as basal, 30 Kg N (20 DAS), 45 kg N (each at 35 and 50 DAS) and 15 kg N (65 DAS)

DAS - Days after sowing, Means followed by same letter did not differ significantly by DMRT (p = 0.05), ** - original values, * - transformed values

CONCLUSION

Higher depth of irrigation and fertilizer levels with its staggered applications favored higher diseases severity in Maize and Soybean sequence cropping under conservation agriculture.

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