Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1002.344>

Irrigation and Fertilizers Management Practices in Maize (*Zea mays* L.) and their Residual Effect on Harvest Index and Soil Moisture Studies of Soybean (*Glycine max* L.)

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ABSTRACT

Keywords

Fertilizer, Hydrogel,
Irrigation, Residual
effect and Time of
application

Article Info

Accepted:
22 January 2021
Available Online:
10 February 2021

Experiment was conducted in sequence cropping (Maize - Soybean) with Soybean as residual crop in *Kharif* at Dharwad on clayey texture in Split split plot with three replications during 2013-14 and 2014-15. Harvest index did not differed significantly with residual effect of irrigation levels. Whereas, residual effect due to fertilizers levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25) recorded significantly higher harvest index (0.41). Similarly, residual effect of fertilizers application as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS recorded higher harvest index (0.40). Besides, residual effect of interaction due to irrigation and fertilizer management practices did not differed significantly on harvest index.

Introduction

From last few years, nutrient research has been shifted from individual crop to cropping system. Presently, efficiency of nutrients (N – 50 %, P₂O₅ – 25 % and K₂O – 30 %) is usually less and remaining nutrients are left over in the soil unless managed properly. Water (reduced water application strategies) and nutrient management practices (adequate and balanced fertilization with split

application of fertilizers), rainfall intensity, soil type, root system and genotype efficiency are the factor which decides availability of cumulative nutrients in the soil. Moreover, water is a scarce input and its management places an important for increasing efficiency of water and nutrients. Adoption of conservation tillage practices reduces decomposition of organic matter and conserves water and nutrients in the soil, besides sustaining short and long term needs

of soil and crop. Hence short duration pulses which require less fertilizer and water can be grown on left over soil moisture and nutrients for economization of resources. Therefore, the present study was planned to examine the above said problems for increasing the productivity.

Materials and Methods

Residual research was carried out in *Kharif* Soybean at Main Agricultural Research Station, Dharwad on clayey texture. Before experimentation, soil sampling of the 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). Experiment was laid out in split split plot design with three replications. Details of treatment are presented in Table 1. Pre-plant (13 ml of glyphosate per litre of water), pre-emergence (4 ml of alachlor per litre of water) and post-emergence herbicides (1 ml of imazethapyr per litre of water) were used for managing weeds. Seeds (JS 335) inoculated with *Rhizobium* (500 g ha⁻¹) were sown with interrow of 30 cm and intrarow of 10 cm. Harvest index was calculated by dividing yield of seed by haulm (Donald, 1962). Besides, soil moisture was estimated by Theta probe from 0-30 and 30-60 cm soil depth. Data were analyzed as per Gomez and Gomez (1984).

Results and Discussion

Harvest index

Irrigation and fertilizer management practices in Maize differed significantly on residual Soybean (Table 1). Residual effect of irrigation levels did not differed significantly with values ranging from 0.38 to 0.40. Residual effect of fertilizer levels differed

significantly with higher harvest index (0.41) from fertilizers dose of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25). Residual effect of fertilizer applications differed significantly with higher harvest index (0.40) with application of fertilizers as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS. Besides, residual interaction effect of irrigation and fertilizer management practices did not differed significantly with values ranging from 0.36 to 0.43. Besides, residual interaction of deficit irrigation at growth stages and fertilizer levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25) when applied as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS recorded higher harvest index (0.43). Higher harvest index might be due to significant dry matter accumulation in vegetative and reproductive parts which resulted in superior seed and haulm yield under suitable climatic conditions. Increased yield is due to higher residual moisture and nutrient resources as a result of higher depth of irrigation and fertilizer management practices in Maize. Similar results were recorded by De (2003), Singh *et al.*, (2009) and Bhattacharyya *et al.*, (2010). In addition, residual effect of control recorded significantly lower harvest index (0.26) due to lower residual growth resources from preceding Maize when compared to other treatment combinations.

Soil moisture content at sowing

Moisture content of soil from 0-30 and 30-60 cm soil depth differed significantly from the residual plot of irrigation and fertilizer management practices (Table 1). Before sowing of Soybean, from 0-30 cm soil depth, residual plot of irrigation levels did not differ significantly, whereas, residual plot of fertilizer levels *i.e.*, 250:100:125 kg

N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25) recorded significantly higher soil moisture content (26.8%). Besides, residual plot of fertilizer applied as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS recorded higher moisture content in the soil (26.8%). Further, residual plot of irrigation at growth stages and fertilizer levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25) with applications as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS recorded significantly higher soil moisture content (27.5%) when compared to other treatment combinations.

Similar trend of results were recorded from 30 to 60 cm soil depth with higher soil moisture content when compared to upper layers. Higher soil moisture content might be due to Minimum tillage in Maize, soil surface covered with maize residues and reduced weed density due to pre plant and pre emergence application of herbicides.

Similar findings were recorded by Gan *et al.*, (2016) and Shrestha and Roy (2016). In addition, residual effect of control recorded soil moisture content of 26.8 and 27.9% from 0-30 and 30-60 cm soil depth, respectively due to conventional agriculture practices.

Soil Moisture content at Harvest

Soil moisture content from 0-30 and 30-60 cm soil depth differed significantly after harvesting Soybean from residual plot of irrigation and fertilizer management practices (Table 1). Soil moisture content from 0-30 cm soil depth after harvesting Soybean did not differ from residual plot of irrigation levels. Whereas, soil moisture content was significantly higher (19.9%) from residual plot of fertilizer plot of 200:75:75 kg N:P₂O₅:K₂O

ha⁻¹ (2.67:1:1). Besides residual plot of fertilizer application as 25% (1/4th) of N, K₂O and 50% of P₂O₅ as basal, 50% of N, P₂O₅ and K₂O at 30 days after sowing and 25% of N and K₂O at 50 days after sowing recorded significantly higher soil moisture content (19.5%).

Low soil fertility might be the reason for low moisture efficiency by Soybean which further conserved in the soil. Residual plot of irrigation at growth stages with Hydrogel and fertilizer levels of 200:75:75 kg N:P₂O₅:K₂O ha⁻¹ (2.67:1:1) with fertilizer application as 25% (1/4th) of N, K₂O and 50% of P₂O₅ as basal, 50% of N, P₂O₅ and K₂O at 30 days after sowing and 25% of N and K₂O at 50 days after sowing documented higher soil moisture content (20.2%) when compared to other treatment combinations. Similar pattern of results were recorded from 30-60 cm soil depth, but moisture content were lower when compared to upper layers.

Increased soil moisture might be due to Soybean sown under Zero tillage, partially decomposed maize residues and pre emergence and post emergence application of herbicides which reduced uptake of moisture by weeds. Similar results were documented by Ali *et al.*, (2000), Bandyopadhyay *et al.*, (2016), Kumar *et al.*, (2018), and Hazra and Bohra (2021). In addition, residual effect of control recorded soil moisture content of 18.1 and 19.4% from 0-30 and 30-60 cm soil depth, respectively due to conventional agriculture practices.

Residual interaction of irrigation at growth stages and fertilizer levels of 250:100:125 kg N:P₂O₅:K₂O ha⁻¹ (2.5:1:1.25) with fertilizers application as 33% each (1/3rd) of N, P₂O₅ and K₂O as basal, 33% each of N, P₂O₅ and K₂O at 30 DAS and 33% each of N, P₂O₅ and K₂O at 50 DAS performed better when compared to other treatment combinations.

Table.1 Harvest index and Soil moisture studies of soybean (*Glycine max* L.) as influenced by residual moisture and nutrient resources

		Harvest index			Soil moisture content at sowing						Soil moisture content at harvest					
					Soil moisture content at 0-30 cm			Soil moisture content at 30-60 cm			Soil moisture content at 0-30 cm			Soil moisture content at 30-60 cm		
		T ₁	T ₂	I × F	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 × T			I × F × T			I × F × T			I × F × T		
I ₁	F ₁	0.36a	0.39a	0.38ab	26.3c-e	26.4b-e	26.3b-d	27.3c-f	27.5c-f	27.4bc	20.1ab	19.8a-c	19.9ab	21.3a	20.8a-c	21.0ab
	F ₂	0.39a	0.41a	0.40ab	26.7a-e	27.4ab	27.1a	27.7b-f	28.4a-c	28.1ab	19.5bc	18.9de	19.2c	20.6b-d	19.9fg	20.2c
	F ₃	0.40a	0.43a	0.42a	26.5a-e	27.5a	27.0ab	27.9a-e	28.7ab	28.3a	18.9de	18.4e-h	18.6d	19.9fg	19.3h	19.6d
I ₂	F ₁	0.36a	0.39a	0.37b	25.9de	26.4b-e	26.2cd	27.2d-f	27.7b-f	27.5bc	20.2a	20.1ab	20.2a	21.3a	21.1ab	21.2a
	F ₂	0.39a	0.40a	0.40ab	26.5a-e	27.3a-c	26.9a-c	27.2d-f	28.3a-d	27.8ab	19.7a-c	18.7e-g	19.2c	20.5c-e	19.5gh	20.0c
	F ₃	0.40a	0.41a	0.40ab	26.3c-e	27.4ab	26.9a-c	27.7b-f	28.9a	28.3a	19.3cd	18.1h	18.7d	20.2d-f	19.1h	19.6d
I ₃	F ₁	0.36a	0.37a	0.36b	25.7e	25.8e	25.8d	26.6f	27.1ef	26.8c	19.9ab	19.6a-c	19.7b	20.9a-c	20.5c-e	20.7b
	F ₂	0.38a	0.40a	0.39ab	26.4b-e	26.0de	26.2cd	27.5c-f	27.5c-f	27.5bc	19.3cd	18.3f-h	18.8d	20.0e-g	19.3h	19.6d
	F ₃	0.39a	0.42a	0.40ab	26.2de	26.9a-d	26.6a-c	27.5c-f	27.9a-e	27.7ab	18.8d-f	18.2gh	18.5d	19.6gh	19.3h	19.4d
		T ₁	T ₂	I	T ₁	T ₂	I	T ₁	T ₂	I	T ₁	T ₂	I	T ₁	T ₂	I
		I × T			I × T			I × T			I × T			I × T		
	I ₁	0.39ab	0.41a	0.40a	26.5bc	27.1a	26.8a	27.6b	28.2a	27.9a	19.5ab	19.0cd	19.2a	20.6a	20.0bc	20.3a
	I ₂	0.38ab	0.40ab	0.39a	26.2c	27.0ab	26.6a	27.4b	28.3a	27.8a	19.7a	19.0cd	19.4a	20.7a	19.9bc	20.3a
		T ₁	T ₂	F	T ₁	T ₂	F	T ₁	T ₂	F	T ₁	T ₂	F	T ₁	T ₂	F
		F × T			F × T			F × T			F × T			F × T		
	F ₁	0.36c	0.38bc	0.37b	26.0c	26.2c	26.1b	27.0d	27.4cd	27.2b	20.1a	19.8ab	19.9a	21.1a	20.8a	21.0a
	F ₂	0.39a-c	0.40ab	0.39ab	26.5bc	26.9ab	26.7a	27.5cd	28.1ab	27.8a	19.5b	18.6d	19.1b	20.4b	19.5d	20.0b
	F ₃	0.39a-c	0.42a	0.41a	26.4bc	27.3a	26.8a	27.7bc	28.5a	28.1a	19.0c	18.2e	18.6c	19.9c	19.2d	19.6c
	T	0.38b	0.40a		26.3b	26.8a		27.4b	28.0a		19.5a	18.9b		20.5a	19.9b	
Control		0.26			26.8			27.9			18.1			19.4		
Comp. of means		S.Em.±			S.Em.±			S.Em.±			S.Em.±			S.Em.±		
I		0.01			0.17			0.18			0.33			0.33		
F		0.01			0.13			0.14			0.08			0.07		
T		0.01			0.10			0.11			0.06			0.06		
I × F		0.01			0.22			0.24			0.13			0.13		
I × T		0.01			0.18			0.19			0.11			0.10		
F × T		0.01			0.18			0.19			0.11			0.10		
I × F × T		0.02			0.31			0.34			0.19			0.18		
Cont. v/s treats.		0.02			0.33			0.34			0.35			0.36		

Residual effect of irrigation levels (I) :	Residual effect of fertilizer levels (F) :	Residual effect due to time of application (T) :	
I ₁ - Deficit irrigation (growth stages)	F ₁ - 200:75:75 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹ (2.67:1:1)	T ₁ - 25% of N, K ₂ O and 50% of P ₂ O ₅ as basal,	T ₂ - 33.3% each of N, P ₂ O ₅ and K ₂ O as basal,
I ₂ - I ₁ + hydrogel (2.5 kg ha ⁻¹)	F ₂ - 225:100:100 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹ (2.25:1:1)	50% of N, P ₂ O ₅ and K ₂ O at 30 DAS and	33.3% each of N, P ₂ O ₅ and K ₂ O at 30 DAS and
I ₃ - Alternately alternate furrow irrigation (50 % depletion of soil moisture)	F ₃ - 250:100:125 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹ (2.5:1:1.25)	25% of N and K ₂ O at 50 DAS	33.3% each of N, P ₂ O ₅ and K ₂ O at 50 DAS
Control : Conventional furrow irrigation with 150:75:37.5 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹ (4:2:1) scheduled as 15 kg N plus full dose of P ₂ O ₅ and K ₂ O as basal, 30 Kg N (20 DAS), 45 kg N (each at 35 and 50 DAS) and 15 kg N (65 DAS)			
MgSO ₄ (10 kg ha ⁻¹) and gypsum (250 kg ha ⁻¹) were applied at sowing for all treatments except control , DAS - Days after sowing, Means followed by same letter did not differ significantly by DMRT (p = 0.05)			

References

- Ali, M., Dahan, R., Mishra, J. P., Saxena, N. P., 2000, Towards the more efficient use of water and nutrients in food legume cropping. In: Knight, R. (eds) Linking research and marketing opportunities for Pulses in the 21st century. *Current Plant Science and Biotechnology in Agriculture*, 34. Springer, Dordrecht. pp. 355-368.
- Bandyopadhyay, P. K., Singh, K. C., Mondal, K., Nath, P., Ghosh, P. K., Kumar, N., Basu, P. S. and Singh, S. S., 2016, Effects of stubble length of Rice in mitigating soil moisture stress and on yield of Lentil (*Lens culinaris* Medik) in Rice - Lentil relay crop. *Agricultural Water Management*, 173: 91-102.
- Bhattacharyya, R., Pandey, S. C., Chandra, S., Kundu, S., Supradip Saha, Mina, B. L., Srivastva, A. K. and Gupta, H. S., 2010, Fertilization effects on yield sustainability and soil properties under irrigated Wheat (*Triticum aestivum* L.) - Soybean (*Glycine max* L.) rotation of an Indian Himalayan upper valley. *Nutrient Cycling in Agroecosystem*, 86(2): 255-268.
- De, J. K., 2003, Residual effect of Black gram in Maize – Black gram cropping sequence in *Ultic Hapludalf* of Assam. *Indian Journal of Agricultural Sciences*, 73(2): 75-78.
- Donald, C. M., 1962, In search of yield. *Journal of Australian Institute of Agriculture Science*, 28: 171-178.
- Gan, Y., Hamel, C., Kutcher, H. R. and Poppy, L., 2016, Lentil enhances agro ecosystem productivity with increased residual soil water and nitrogen. *Renewable Agriculture and Food Systems*, 32(4): 319–330.
- Gomez, K. A. and Gomez, A. A., 1984, *Statistical Procedure for Agricultural Research*. John Wiley and Sons, New York, pp. 130-271.
- Hazra, K. K. and Bohra, A., 2021, Increasing Relevance of Pulse crops to sustainable intensification of Indian Agriculture. *National Academy Science Letters*, 44: 1–3.
- Kumar, N., Yadav, A., Singh, S. and Yadav, S. L., 2018, Growing pulses in Rice fallow: ensuring nutritional security in India. *Conservation Agriculture for Advancing Food Security in Changing Climate*, 1: pp. 107-122.
- Shrestha, B. B. and Roy, P., 2016, Utilisation of residual soil moisture through relay cropping. *Working Paper*, pp. 1-51.
- Singh, K. K., Ali, M. and Venkatesh, M. S., 2009, Pulses in Cropping Systems. *Technical Bulletin*, IIPR, Kanpur. pp. 1-47.

How to cite this article:

Sangh Ravikiran and Angadi, S. S. 2021. Irrigation and Fertilizers Management Practices in Maize (*Zea mays* L.) and their Residual Effect on Harvest Index and Soil Moisture Studies of Soybean (*Glycine max* L.). *Int.J.Curr.Microbiol.App.Sci*. 10(02): 3141-3145.
doi: <https://doi.org/10.20546/ijcmas.2021.1002.344>