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RESEARCH ARTICLE

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Effect of Nutrients on Wilt in Chickpea

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ABSTRACT

Background: Chickpea (*Cicer arietinum* L.) contributes 18% of the global production of grain legume and serves as an important source of dietary protein. Fusarium wilt, caused by soil borne fungus *Fusarium oxysporum* f. sp. ciceri appears to be the most devastating diseases of chickpea throughout the world. It is one of the important limiting factors of chickpea production in India. The disease causes substantial yield losses which may reach even 100 per cent under favorable weather conditions.

Methods: Pot culture experiments were conducted at Rajasthan Agricultural Research Institute, Durgapura, Jaipur during *rabi* 2014-15 and 2015-16 to study the effect of nutrients on wilt caused by *Fusarium oxysporum* f. sp. ciceri (Padwick) in chickpea (*Cicer aritinum*). In the first experiment, the treatments comprised of four nitrogen levels-*viz.* 0, 15, 20 and 25 kg/ha and four phosphorus levels- *viz.* 0, 30, 40 and 50 kg/ha tried in sixteen treatment combinations. Surface sterilized seeds of chickpea cultivar L-550 were sown in each pot. After sowing, 400 ml water was supplied to each pot; there after watering was done at an interval of 6 days. In second experiment, the treatments comprised of 7 micronutrients *viz.* zinc, manganese, calcium, copper, cobalt, iron and nickel used at the rate of 10mg/kg of soil. Chickpea cultivar L-550 was used as a test crop.

Result: Disease incidence was recorded periodically commencing 15 days after sowing and was continued up to 55 days after sowing. Levels of nitrogen application had increased wilt incidence successively in both the years. Whereas, a reverse trend was observed with the application of phosphorus, incidence of wilt was decreased with increasing levels of phosphorus. Application of zinc and calcium reduced the wilt incidence significantly over check. Zinc was found to be most effective in minimizing the disease incidence.

Key words: Chickpea, *Fusarium oxysporum,* Micro-nutrients, Nitrogen, Phosphorus, Wilt.

INTRODUCTION

Chickpea is the third most important grain legume after common bean and pea (Anwar *et al*., 2009). Asia covers 89.7 per cent of the area in chickpea cultivation followed by 4.3 per cent in Africa, 2.6 per cent in Oceania, 2.9 per cent in America and 0.4 per cent in Europe (Gaur *et al*., 2010). India ranks first in terms of chickpea production and consumption in the world. About 65 per cent of the global area with 68 per cent of global production is contributed by India (Reddy and Mishra, 2006). It accounts for 70 per cent of the cultivated *rabi* pulses in India. The major chickpea growing states in India are Madhya Pradesh, Rajasthan, Andhra Pradesh, Bihar, Uttar Pradesh, Maharashtra, Haryana and Karnataka. The total area under chickpea cultivation in India is about 9.93 million hectare with an annual production of 9.53 million tonnes. The average productivity of chickpea is 960 kg/ha (Anonymous, 2015).

Among the fungal diseases, chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri* is widespread in several countries of the world like India, Iran, Pakistan, Nepal, Burma, Spain, Mexico, Peru, Syria and USA (Nene *et al.,* 1989; Jalali and Chand, 1992). It is one of the important limiting factors of chickpea production in India. The disease causes substantial yield losses which may reach even 100 per cent under favorable weather conditions (Nene 1980, Jalali and Chand, 1992). Characteristic symptoms of wilt are sudden drooping of leaves and petioles, no external rotting of roots and black internal discoloration involving xylem and pith (Dubey and Singh, 2004). The disease is characterized by two syndromes, namely vascular wilt and yellowing that can be distinguished by both symptomlogical and chronological development.

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MATERIALS AND METHODS

Pot culture experiments were carried out during 2014-15 and 2015-16 were carried out to study the effect of macro and micro nutrients on the wilt disease of chickpea. The experimental soil was loamy sand, neutral in reaction, low in nitrogen and medium in phosphorus and potash. The pH, electric conductivity (EC) and organic carbon were being 8.2, 0.15 dsm^{-1} and 0.15 per cent, respectively. Soil mixed with *Fusarium oxysporum* f.sp. *ciceri* inoculums multiplied on maize-meal-sand medium at the rate of 10 per cent (w/w) was filled in earthen pots of 30 cm diameter after lining the pots with polyethylene sheet of 40 µm gauge. Four nitrogen levels *viz.*, 0, 15, 20 and 25 kg/ha and four levels of phosphorus *viz.*, 0, 30, 40 and 50 kg/ha were tried in sixteen different combinations. Required quantity of urea and single super phosphate were added in soil in order to achieve the desired levels of nitrogen and phosphorus, respectively. In each pot 7 kg sterilized soil was filled. Quantity of each fertilizer in each pot (7 kg soil) was calculated on the basis of weight of the soil, 0, 105.91, 141.19, 176.59 mg of urea and 0, 595.59, 795.34 and 994.31 mg SSP were added to supply the above-mentioned levels of N and P, respectively. Four replications (4 pots) in each combination treatment were maintained. Fifteen surface sterilized seeds of chickpea cultivar L-550 were sown in each pot. After sowing, 400 ml water was supplied to each pot, thereafter watering was done at an interval of 6 days. Disease incidence was recorded periodically commencing after 15 days of sowing and was continued up to 55 days. The pathogen population was also determined in terms of mycelia spores per gram of soil.

For study of micro-nutrients, plastic pots of 10 cm diameter were used. Seven micro-nutrients *viz.*, zinc, manganese, calcium, copper, cobalt, iron and nickel were tried. Each element at the rate of 10 mg kg^{-1} of soil was applied in *Fusarium oxysporum* f. sp. *Cicero* inoculated soil. Nitrogen and phosphorus were applied at 20 kg N and 40 kg P_2O_5/ha as a general dose in all the treatments. Five surface sterilized seeds of chickpea cultivar L-550 were sown in each pot. Each treatment was replicated eight times. After sowing 25 ml water was supplied to each pot thereafter, watering was done at an interval of 6 day. Disease incidence was recorded 7 days after sowing and continued till 55 days. Pathogen population and incubation period were also recorded. Micronutrients were supplied in the form of chemicals as given below.

Micronutrient	Name of chemical	*Quantity/kg soil (in mg)
Zinc	Zinc sulphate	29.68
Manganese	Manganese sulphate	27.44
Calcium	Calcium sulphate	40.50
Copper	Copper sulphate	29.36
Cobalt	Cobalt chloride	25.58
Iron	Ferrous sulphate	32.50
Nickel	Nickel chloride	26.60

*To supply 10 mg kg^{-1} of soil of each nutrient.

RESULTS AND DISCUSSION

Effect of macro-nutrients during 2014-15

The increasing levels of nitrogen increased the mean disease incidence successively. Minimum disease incidence of 39.19 and 40.06 per cent was recorded when no (zero) nitrogen was applied to the plants in the years 2014-15 and 2015-16, respectively. Whereas, the incidence of the disease was maximum 65.99% and 65.91 when chickpea plants were supplied with the highest dose of nitrogen 25 kg ha^{-1} during 2014-15 and 2015-16, respectively.

A reverse trend was noticed in case of phosphorus. Incidence of wilt of chickpea was decreased with the increasing levels of phosphorus. Minimum wilt incidence of 43.13 and 44.01 per cent was recorded when the highest dose of phosphorus, 50 kg ha^{-1} was applied during 2014-15 and 2015-16, respectively.

Interactions between nitrogen and phosphorus levels were found to be significant with the highest dose of phosphorus (50 kg ha^{-1}) and zero application of nitrogen and exhibited the lowest disease incidence of 33.58 per cent (Table 1). Interactions between nitrogen and phosphorus were found significant. The minimum disease incidence of 34.13 per cent was recorded when zero level of nitrogen and 50 kg phosphorus was applied, as against 68.80 per cent in plants supplied with 25 kg N and 0 level of P per hectare (Table 2).

Effect of macro-nutrients during 2015-16

Increased levels of nitrogen resulted in increase in wilt disease incidence. However when phosphorus levels were increased from 0 to 50 kg/ha disease incidence had gone down in general, it has been observed that when nitrogen and phosphorus were applied in combinations. The effect of nitrogen was suppressed by increasing levels of phosphorus. Similar observations have been recorded by Singh *et al.* (2002), Bharati and Rao (2009) and Harichand and Khirabat (2009) who observed that the development of wilt is favoured by increase in nitrogen.

Effect of micro-nutrients

Application of zinc and calcium reduced the wilt incidence significantly over check. Zinc was found to be most effective in minimizing the disease with incidence of 41.68 and 43.43 per cent in the year 2014-15 and 2015-16, respectively. This treatment was closely followed by calcium and found statistically at par with the disease incidence of 43.68 per cent during 2014-15. However, it was significantly super to zinc application in the year 2015-16 (Table 3). All the micronutrient applied significantly reduced the disease incidence over control. However, the application of copper, iron, manganese, cobalt and nickel were less effective as compared to zinc and calcium. Lowest pathogen population was observed at 1.6 x 10^3 spores/g of soil when the soil was amended with zinc followed by calcium having pathogen population of 1.80 x 10^3 spores g^{-1} of soil. The highest pathogen population of 2.2 x 10^3 spores was observed when the soil was amended with nickel (Table 3).

Soil application of zinc and calcium reduced the wilt disease incidence. Similarly, a marked reduction in pathogen population of *Fusarium oxysporum* f.sp. *ciceri* was also observed when soil was amended by zinc and calcium. On the contrary increase in disease incidence as well as pathogen population were noted when the soil was amended by nikel. Application of zinc is reported to control *Fusarium*

Table 1: Effect of nitrogen and phosphors levels on wilt incidence of chickpea induced by *F. oxysporum* f.sp.*ciceri* during 2014-15.

Nitrogen levels (kg ha^{-1})	Mean of wilt incidence (%) Phosphorus levels (kg ha^{-1})				Mean
	P_0	P_{30}	P_{40}	P_{50}	
N_0	44.50 (41.84)	40.20 (39.35)	38.50 (38.35)	33.58 (35.41)	39.19 (38.76)
N_{15}	46.08 (42.75)	41.45 (40.08)	38.65 (38.44)	35.46 (36.41)	40.41 (39.41)
N_{20}	53.65 (47.09)	43.63 (41.34)	42.35 (40.60)	41.95 (40.37)	45.39 (42.35)
N_{25}	68.85 (56.07)	67.75 (55.40)	65.85 (54.24)	61.53 (51.66)	65.99 (54.33)
Mean	53.27 (46.87)	48.25 (44.00)	46.33 (42.90)	43.13 (41.05)	
	S.Em ±	CD at 5 %	CV (%)		
Nitrogen	0.23	0.68	2.00		
Phosphorus	0.23	0.68			
Nitrogen × Phosphorus	0.48	1.36			

Figures in parentheses are angular transformed values.

Table 2: Effect of nitrogen and phosphors levels on wilt incidence of chickpea induced by *F. oxysporum* f.sp. *ciceri* during 2015-16.

Nitrogen levels (kg ha^{-1})	Mean of wilt incidence (%) Phosphorus levels (kg ha^{-1})				Mean
	P_0	P_{30}	P_{40}	P_{50}	
N_0	45.35(42.33)	41.40(40.05)	39.35(38.85)	34.13(35.74)	40.06(39.27)
N_{15}	47.48(43.55)	43.18(41.08)	39.83(39.13)	37.28(37.63)	41.94(40.36)
N_{20}	53.30(46.89)	44.43(41.80)	43.10(41.03)	42.43(40.64)	45.81(42.64)
N_{25}	68.80(56.04)	66.73(54.77)	65.90(54.27)	62.23(52.08)	65.91(54.28)
Mean	53.73 (47.14)	48.93(44.39)	47.04(43.30)	44.01(41.56)	
	S.Em ±	CD at 5 %	CV (%)		
Nitrogen	0.20	0.57			
Phosphorus	0.20	0.57	1.67		
Nitrogen × Phosphorus	0.40	1.14			

Figures in parentheses are angular transformed values.

Table 3: Effect of micronutrient on wilt incidence of chickpea induced by *F. oxysporum* f.sp.*ciceri*.

Micronutrient	Dose	Wilt disease incidence (%)		Pathogen Spores
	mg kg^{-1} soil	2014-15	2015-16	g^{-1} soil
Zn	10	41.68(40.21)	43.43 (41.22)	1.6×10^3
Cu	10	55.75(48.30)	56.38 (48.66)	1.9×10^3
Co	10	60.20(50.89)	63.70(52.96)	2.2×10^3
Mn	10	57.90(49.55)	58.95(50.16)	2.1×10^3
Ca	10	43.68(41.36)	46.48(42.98)	1.8×10^3
Fe	10	57.55(49.34)	61.28(51.52)	2.0×10^3
Ni	10	60.85(51.27)	65.53(54.04)	2.3×10^3
Control	-	63.10(52.60)	67.18(55.05)	2.4×10^3
S.Em. ±		0.76	0.52	
C.D.at 5 %		2.23	1.55	
C.V. %		2.76	1.94	

Figures in parentheses are arcsine √ per cent angular transformed values.

wilt in some crops. These results are consistent with the findings of Sanjeev and Eswaran (2008) who studied the efficacy of micro nutrient *viz.*, calcium nitrate, ammonium sulphate, copper sulphate, potassium chloride, sodium chloride, borax, ferrous sulphate and zinc sulphate against *Fusarium oxysporium* f.sp. *cubence* (Panama wilt of banana) and found that among the micro nutrients used borax @500 and 750 ppm completely inhibited the mycelial growth of *Fusarium oxysporium* f.sp*. cubence* fallowed by zinc sulphate (100, 250, 500 and 750 ppm).

REFERENCES

Anonymous (2015). dacnet.nic.in. (Department of Agriculture and Cooperation) Developed by Agricultural Informatics Division, National Informatics Centre, Department of Information Technology, Ministry of Information and Communication Technology. Govt. of India, New Delhi.

Anwar, F., Sharmila, P. and Saradhi, P.P. (2009). No More Hurdle: *in vitro* Chickpea Rooting and Cent Percent Transplantation. Australian Journal of Basic Applied Science. 3(3): 2491-2496.

Bharathi, V. and Rao, K.C. (2009). Effect of cropping systems and nitrogen on wilt incidence, Fusarium udum population and its antagonistic fungi in pigeon pea rhizosphere. International Journal of Plant Protection. 2(1): 8-11.

Dubey, S.C. and Singh, B. (2004). Reaction of chickpea genotypes against *Fusarium oxysporum* f. sp. *ciceri* causing vascular wilt. Indian Phytopatholgy. 57: pp. 233.

Gaur, P.M., Tripathi, S., Gowda, C.L.L., Ranga Rao, G.V., Sharma, H.C., Pande, S. and Sharma, M. (2010). Chickpea Seed Production Manual, ICRISAT. pp.28.

Harchand and Khirbat, S.K. (2009). Chickpea wilt and its management- a review. Agricultural Reviews. 30(1): 1-12.

Jalali, B.L. and Chand, H. (1992). Chickpea wilt. Plant Diseases of International Importance. 1: pp. 429-444.

Nene, Y.L. (1980). Diseases of Chickpea. In: Proceedings of International Workshop on Chickpea Improvement, 28 February- 2 March 1979, ICRISAT, India. Patancheru, Andhra Pradesh, India. Pp 171-178.

Nene, Y.L., Sheila, V.K. and Sharma, S.B. (1989). A world list of chickpea (*Cicer arietinum* L.) and pigeon pea (*Cajanus cajan* L.) Millsp. pathogens. ICRISAT Legumes Pathology Progress Report vol. 7, Patancheru, India.

Reddy, A.A. and Mishra, D. (2006). Growth and instability in chickpea production in India: A state level analysis. Agricultural Situation in India. 230-145.

Sanjeev, K.K. and Eswaran, A. (2008). Efficacy of micro nutrients on banana fusarium Wilt (*Fusarium oxysporum* f. sp. *cubense*) and its synergistic action with *Trichoderma viride*. Notulae Botanicae Horti Agrobotanici Cluj-Napoca. 36(1): 52-54.

Singh, R., Prasad, D.C., Singhal, V. and Randhawa, G.J. (2002). Analysis of genetic diversity in *Cicer arietinum* L. using random amplified polymorphic DNA markers. Journal of Plant Biochemistry Biotechnoly. 11: 109-112.