

Efficacy of Organic Amendments and Bio-Agents for Management of Chickpea Wilt in Field Conditions

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Abstract— Chickpea (*Cicer arietinum* L.) is the second most important crop in the world after dry bean. It belongs to the family Fabaceae. A large number of diseases have been reported on chickpea among them wilt is caused by *Fusarium oxysporum* f. sp. *ciceri*. The evaluation of organic amendments viz., neem cake, castor cake and mustard cake and two bio-agent viz., *Trichoderma viride* and *T. harzianum* were selected for individual as well as with combination in field conditions. Per cent disease incidence was recorded at 60, 90 DAS and at harvest. After 60 DAS, minimum PDI (09.01%) was recorded in neem cake (500 kg ha⁻¹) + *T. viride* (2.5 kg ha⁻¹) which was followed by neem cake (500 kg ha⁻¹) + *T. harzianum* (2.5 kg ha⁻¹) (13.09%). The same results were observed after 90 days of sowing and at harvest. In yield, the maximum yield (1407 kg ha⁻¹) was noted in neem cake (500 kg ha⁻¹) + *T. viride* (2.5 kg ha⁻¹), whereas minimum yield (867 kg ha⁻¹) in *T. harzianum* (2.5 kg ha⁻¹).

Keywords— Chickpea, wilt, organic amendments, bio-agents and per cent disease incidence.

I. INTRODUCTION

Pulses are recognized as one of the most important sources of edible vegetable proteins, which are taken in the form of dal. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999). Among the pulse crops, Chickpea (*Cicer arietinum* L.) is the second most important crop in the world after dry bean. It belongs to the family Fabaceae. Chickpea seed contains 17-24 per cent of protein, 61.2 per cent carbohydrates, 9.8 per cent moisture (Smartt, 1976) and essential amino acids like isoleucine, leusine, lysine, phenylalanine and valine (Karim and Fattah, 2006).

Global production of pulses is 60 MT. Globally India ranked first in pulses production. Area, production and productivity of chickpea in India are 31.03 million hectares, 27.69 MT and 892 kg ha⁻¹ respectively. Among the states of India, Madhya Pradesh ranked first in area and production of chickpea followed by Maharashtra, Rajasthan and Gujarat (Anon., 2022a). In Gujarat, chickpea was grown in 11016 hectares, producing 21014 MT with an average productivity of 1908 kg ha⁻¹, which is high as compared to national average productivity (Anon., 2022b).

A large number of diseases have been reported on chickpea viz. fusarium wilt [*Fusarium oxysporum* Schlechtend.: Fr. f. sp. *ciceri* (Padwick) T. Matuo & K. Sato], black root rot [*Fusarium solani* (Mart.) Sacc.], dry root rot [*Macrophomina phaseolina* (Tassi) Goidanich], wet root rot [*Rhizoctonia solani* Kuhn] and collar rot [*Sclerotium rolfsii* Sacc.] are of considerable importance (Nene *et al.*, 1981). Among them, chickpea wilt complex is considered the most important, devastating and challenging one, being responsible for seed rot, seedling blight, root rot and mature plant wilt, culminating in 60-70 per cent yield loss (Tewari and Mukhopadhyay, 2001) The disease complex observed first in the history caused by *Fusarium* and

Meloidogyne species on cotton (Atkinson, 1892). Wilt complex caused by several soil-borne pathogens is the major yield reducing malady.

Chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri* was first reported from India by Butler (1918). The mystery of the chickpea wilt complex was solved by Nene *et al.* (1979) in India and also developed multiple disease resistance screening techniques and disease-resistant varieties. The wilting pathogens are seed-borne (Haware *et al.*, 1978; Pande *et al.*, 2007) as well as soil-borne (Jimenez-Fernandez *et al.*, 2011) in nature. The mycelium and chlamydospores can survive in seed and soil, and also infected crop residues, roots and stem tissue buried in the soil more than the six years in absence of host plant (Haware *et al.*, 1986).

II. MATERIAL AND METHODS

The field experiment was conducted during *Rabi* 2023-24 at Agronomy Instructional Farm, S. D. Agricultural University, S. K. Nagar for the management of wilt complex of chickpea through bio-agents and organic amendments individual as well as combination. The three organic amendments viz., neem cake, castor cake, mustard cake and two bio-agents viz. *T. viride*, *T. harzianum* were selected for individual as well as with combination in field conditions as below.

TABLE 1
DETAILS OF EXPERIMENT

Sr. No.	Content	Descriptions
1	Experimental site	Agronomy Instructional Farm, SDAU, Sardarkrushinagar
2	Season	2023-24 (<i>Rabi</i>)
3	Design	Randomized Block Design
4	Variety	GJG 3
5	Spacing	45 × 10 cm
6	Treatments	12 (Twelve)
7	Replications	3 (Three)
8	Plot size	Gross: 4.5 × 5.0 m

III. OBSERVATIONS RECORDED:

3.1 Disease incidence:

Percent disease incidence of wilt was calculated from each plot after 60, 90 days of sowing and at harvest by using following formula,

$$\text{Per cent Disease Incidence (PDI)} = \frac{\text{Total no. of infected plants}}{\text{Total no. of plants}} \times 100$$

IV. RESULT AND DISCUSSION

The three organic amendments viz., neem cake, castor cake and mustard cake and two bio-agent viz., *T. viride* and *T. harzianum* were selected for individual as well as with combination in field conditions. Observations on disease incidence was taken at 60, 90 days after sowing (DAS) and at harvest (Table 2).

TABLE 2
EFFICACY OF ORGANIC AMENDMENTS AND BIO-AGENT FOR MANAGEMENT OF CHICKPEA WILT IN FIELD CONDITIONS

Tr. No.	Treatment	Disease Incidence (%)			Yield (Kg ha ⁻¹)
		60 DAS	90 DAS	At harvest	
T ₁	Neem cake (500 kg ha ⁻¹)	26.00 ^{bcd} (19.22)	29.36 ^{cd} (24.04)	33.81 ^{bc} (30.96)	1063 ^{bc}
T ₂	Castor cake (500 kg ha ⁻¹)	29.72 ^{bc} (24.58)	33.56 ^{bc} (30.55)	38.38 ^b (38.54)	943 ^{cd}
T ₃	Mustard cake (500 kg ha ⁻¹)	29.90 ^b (24.84)	33.71 ^{bc} (30.79)	38.61 ^b (38.94)	937 ^{cd}
T ₄	<i>T. viride</i> (2.5 kg ha ⁻¹)	29.61 ^{bc} (24.41)	33.30 ^{bcd} (30.14)	38.05 ^b (37.98)	987 ^{cd}
T ₅	<i>T. harzianum</i> (2.5 kg ha ⁻¹)	30.00 ^b (25.00)	33.90 ^b (31.10)	38.72 ^b (39.13)	867 ^d
T ₆	Neem cake (500 kg ha ⁻¹) + <i>T. viride</i> (2.5 kg ha ⁻¹)	17.47 ^f (09.01)	20.35 ^g (12.10)	23.54 ^f (15.96)	1407 ^a
T ₇	Neem cake (500 kg ha ⁻¹) + <i>T. harzianum</i> (2.5 kg ha ⁻¹)	21.21 ^e (13.09)	24.52 ^f (17.22)	28.34 ^e (22.54)	1220 ^b
T ₈	Castor cake (500 kg ha ⁻¹) + <i>T. viride</i> (2.5 kg ha ⁻¹)	21.55 ^e (13.49)	24.76 ^{ef} (17.54)	28.56 ^{de} (22.86)	1217 ^b
T ₉	Castor cake (500 kg ha ⁻¹) + <i>T. harzianum</i> (2.5 kg ha ⁻¹)	21.86 ^e (13.86)	24.93 ^{ef} (17.77)	28.78 ^{cde} (23.18)	1197 ^b
T ₁₀	Mustard cake (500 kg ha ⁻¹) + <i>T. viride</i> (2.5 kg ha ⁻¹)	25.54 ^d (18.59)	28.91 ^{def} (23.37)	33.48 ^{bcd} (30.42)	1117 ^{bc}
T ₁₁	Mustard cake (500 kg ha ⁻¹) + <i>T. harzianum</i> (2.5 kg ha ⁻¹)	25.86 ^{cd} (19.03)	29.09 ^{de} (23.63)	33.65 ^{bcd} (30.7)	1100 ^{bc}
T ₁₂	Control	33.76 ^a (30.88)	38.17 ^a (38.19)	43.52 ^a (47.42)	630 ^e
S. Em.±		1.24	1.39	1.61	57.92
C. D. at 5%		3.63	4.07	4.71	169.88
C. V. %		8.23	8.14	8.2	9.49

Figures in parentheses are retransformed values of arcsine transformed values.

Treatment means with the common letter(s) are not significant by Duncan's New Multiple Range Test at 5% level of significance

All the treatments applied before sowing

All treatments were highly effective as compare to control. Among the all treatments, combination of treatments was highly effective than individual treatments. All treatments were highly effective as compare to control. Among the all treatments, combination of treatments was highly effective than individual treatments. After the 60 days of sowing the minimum disease incidence (09.01%) was observed in treatments of neem cake (500 kg ha⁻¹) + *T. viride* (2.5 kg ha⁻¹) which was followed by neem cake (500 kg ha⁻¹) + *T. harzianum* (2.5 kg ha⁻¹) (13.09%) and maximum disease incidence (25.00%) was observed in *T. harzianum* (2.5 kg ha⁻¹) alone. After 90 DAS, minimum PDI (12.10%) was recorded in neem cake (500 kg ha⁻¹) + *T. viride* (2.5 kg ha⁻¹) which was followed by neem cake (500 kg ha⁻¹) + *T. harzianum* (2.5 kg ha⁻¹) (17.22%). At harvest, minimum PDI (17.96%) was recorded in neem cake (500 kg ha⁻¹) + *T. viride* (2.5 kg ha⁻¹) which was followed by neem cake (500 kg ha⁻¹) + *T. harzianum* (2.5 kg ha⁻¹) (22.54%). Maximum yield (1407 kg ha⁻¹) was noted in treatment neem cake + *T. viride* which was followed by neem cake + *T. harzianum* (1220 kg ha⁻¹), castor cake + *T. viride* (1217 kg ha⁻¹) and castor cake + *T. harzianum* (1197 kg ha⁻¹) whereas minimum in *T. harzianum* (867 kg ha⁻¹).

These results are also confirmity with Barnwal (2009) showed that minimum wilt incidence, maximum yield and maximum ICBR recorded when seed priming with *T. viride* + soil application of neem cake. Same result confirmed by Mahanthi *et al.* (2019), Kumari *et al.* (2020) and Shekhawat *et al.* (2021).

V. CONCLUSION

The study demonstrated that integrating organic amendments with bio-agents significantly reduces chickpea wilt incidence and enhances crop yield. Among the tested treatments, neem cake + *T. viride* was the most effective, achieving the lowest disease incidence and the highest yield under field conditions. This suggests that the combination of organic amendments and bio-control agents can serve as a sustainable and eco-friendly approach to managing chickpea wilt complex.

Furthermore, these treatments not only improve plant health but also contribute to soil fertility by fostering beneficial microbial activity. Given the increasing concern over chemical pesticides and soil degradation, adopting such integrated disease management strategies can play a vital role in sustainable chickpea production. Future research should explore the long-term effects of these treatments on soil microbial diversity and crop productivity across different agro-climatic regions.

REFERENCES

- [1] Anonymous, (2022a). Directorate of Pulses Development (<https://dpd.gov.in>)
- [2] Anonymous, (2022b). District-wise Area, Production and Yield of Important Food & Non-food Crops in Gujarat State (<https://dag.gujarat.gov.in>)
- [3] Atkinson, G. F. (1892). Some diseases of cotton. *Alabama Agricultural Experiment Station Bulletin*, **41**: 65.
- [4] Barnwal M. K. (2009). Role of bioagents and organic amendments in the management of chickpea wilt under field condition. *Journal of Biological Control*, **23**(2):199-202.
- [5] Butler, E. J. (1918). *Fungi and diseases in plants*. Thacker Spink and Company, Calcutta, India. pp. 547.
- [6] Haware, M. P.; Nene, Y. L. and Natrajan, M. (1986). The survival of *Fusarium oxysporum* f. sp. *ciceri* in the soil in absence of chickpea. *Phytopathologia Mediterranea*, **35**: 9-12.
- [7] Haware, M. P.; Nene, Y. L. and Rajeshwari, R. (1978). Eradication of *Fusarium oxysporum* f. sp. *ciceri* transmitted in chickpea. *Seed Phytopathology*, **68**: 1364- 1367.
- [8] Jimenez-Fernandez, D.; Montes-Borrego, M.; Jimenez-Diaz, R. M.; Navas-Cortes, J. A. and Landa, B. B. (2011). In planta and soil quantification of *Fusarium oxysporum* f. sp. *ciceri* and evaluation of Fusarium wilt resistance in chickpea with a newly developed quantitative polymerase chain reaction assay. *Phytopathology*, **1**(2): 250-262
- [9] Kannaiyan, S. (1999). Bioresources technology for sustainable agriculture. Associated Publishing Company, New Delhi. pp. 4-22.
- [10] Karim, M. F. and Fattah, Q. A. (2006). Changes in biocomponents of chickpea (*Cicer arietinum* L.) sprayed with potassium naphthenate and naphthenic acetic acid. *Bangladesh Journal of Botany*, **35**(1): 39-43.
- [11] Kumari, M.; Sharma O. P.; Bagri R. K. and Nathawat B. D. S. (2020). Management of wilt disease of lentil through bio control agents and organic amendments in Rajasthan. *Journal of Pharmacognosy and Phytochemistry*, **9**(5): 3248-3252.
- [12] Mahanthi, K.; Tiwari, S. and Subhadarshini, A. (2019). Management of *Fusarium* wilt of pigeon pea by selected essential oils and *T. viride*. *International Journal of Current Microbiology and Applied Sciences*, **8**(11): 596-605.
- [13] Nene, Y. L.; Haware, M. P. and Reddy, M. V. (1981). Chickpea diseases: resistance screening techniques. *ICRISAT Information Bulletin*, **10**: 1-8.
- [14] Nene, Y. L.; Kannaiyan, J.; Haware, M. P. and Reddy, M. V. (1979). Review of the work done at ICRISAT on soil-borne diseases of pigeon pea and chickpea. *ICRISAT Information Bulletin*, pp. 78.
- [15] Pande, S.; Rao, J. N. and Sharma, M. (2007). Establishment of the chickpea wilt pathogen *Fusarium oxysporum* f. sp. *ciceri* in the soil through seed transmission. *The Plant Pathology Journal*, **23**(1): 3-6.
- [16] Shekhawat D.; Tiwari, S. and Nathawat, B. D. S. (2021). *Fusarium* wilt in chickpea (*Cicer arietinum* L.) caused by *Fusarium oxysporum* f. sp. *ciceris* management through combination of essential oils and bioagents. *Journal of Pharmacognosy and Phytochemistry*, **10**(1): 901-904.
- [17] Smartt, J. (1976). Tropical Pulses. Tropical Agriculture Series: Southampto Univ. Longman Group Ltd., London, pp. 96
- [18] Tewari, A. K. and Mukhopadhyay, A. N. (2001). Testing of different formulation of *Gliocladium virens* against chickpea wilt complex. *Indian Phytopathology*, **54**: 64- 71.