



Role of bioagents and organic amendments in the management of chickpea wilt under field condition

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ABSTRACT: Pooled analysis of data on wilt incidence in 3 years (2004-05, 2005-06 and 2006-07) showed that the minimum wilt incidence of 15.6 % was recused in plots with seed priming with *T. viride* @ 4g kg⁻¹ seed plus soil application of neem oil cake @ 250kg ha⁻¹. It also recorded the maximum grain yield of 14.9 q ha⁻¹, 35.2 % increase in yield over control with cost benefit ratio of 1: 2.7. This treatment was at par with seed priming with *T. viride* @ 4g kg⁻¹ seed and soil application of karanj and 38% oil cake @ 200kg ha⁻¹ that recorded wilt incidence of 18.1%, grain yield of 14.1q ha⁻¹ and 38% increase in yield over control with cost benefit ratio of Rs. 1: 4.8. Soil application of FYM @ 1.0t ha⁻¹ having *T. viride* @ 1.0kg q⁻¹ of FYM, recorded 18.3%wilt incidence and 13.8q ha⁻¹ grain yield.

KEY WORDS: Chickpea, cost-benefit ratio, management, neem oil cake, *Pongamia glabra* oil cake, *Pseudomonas fluorescens*, *Trichoderma viride*, wilt, yield losses.

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown in India. Wilt caused by *Fusarium oxysporum* f. sp. *ciceri* (Padwick) Matuo and K. Sato is a potential threat to chickpea cultivation (Dhar and Chaudhary, 2001; Rudresh *et al.*, 2005). This disease is soil borne in nature and pathogen remains viable in soil for several months (Haseeb *et al.*, 2006). Biological control is a viable ecofriendly preposition, which can considerably minimize the disease. Biocontrol potential of *Trichoderma viride*, *Pseudomonas fluorescens* and oil cakes against soil borne diseases of many crops has been reported (Kaur and Mukhopadhyay, 1992; Prasad *et al.*, 2002; Neelamegam *et al.*, 2005; Ramakrishnan *et al.*, 1997). The present experiments were undertaken to study the role of bioagents and organic matters in the management of chickpea wilt under field condition.

Field trials were conducted during *Rabi* season in 2004-05, 2005-06 and 2006-07 at the Zonal Research Station, Darisai Farm of Birsa Agricultural University located at East Singhbhum district of Jharkhand State. Neem (*Azadirachta indica*) oil cake and Karanj (*Pongamia glabra*) oil cake were incorporated into the plots five days before sowing as per (Table 1) whereas, FYM containing bioagents were incorporated in furrow at the time of sowing. Talc based formulation of *T. viride* and *P. fluorescens* were used @ 2×10^8 and 2×10^9 CFU g⁻¹, respectively. The details of treatments are given in Table 1. The plots devoid of any amendment and biocontrol agent served as check.

Seeds were primed with 25g Jaggery + 1000ml water + 4g *T. viride* or *P. fluorescens* kg⁻¹ seed and were dried in shade over night before sowing in field. For soil application,

talc based formulation of *T. Viride* / *P. fluorescens* were used.

Preparation of talc based formulation of *T. viride*

T. viride was grown in molasses broth (molasses - 30g, yeast extract - 5g, distilled water - 1000ml) for 10 days at $27 \pm 2^\circ\text{C}$. Subsequently broth cultures were homogenized using a mixer grinder. The homogenized liquid cultures were formulated using talc as a carrier material (talc: liquid broth culture of *T. viride* @ 2: 1 w/v) with 10g of carboxy methyl cellulose (CMC) per kilogram of carrier material as adhesive and dried to 8 - 10% moisture under shade and packed in white polythene bags and sealed. Formulation was stored at $27 \pm 2^\circ\text{C}$.

Preparation of talc based formulation of *P. fluorescens*

P. fluorescens was multiplied on King's B medium (King *et al.*, 1954). A loop ful of the bacterium was inoculated into the King's B broth (peptone - 20g, glycerol - 10g, K₂HPO₄ - 1.5g, MgSO₄ - 1.5g, distilled water - 1000ml) and inoculated in rotatory shaker at 150rpm for 48h at room temperature ($28 \pm 1^\circ\text{C}$). The bacterium grown in the broth was formulated using talc as carrier material (talc: liquid broth culture of *P. fluorescens* @ 2: 1 w/v) with 10g of carboxy methyl cellulose (CMC) per kilogram of carrier material as adhesive and dried to 8 - 10 % moisture under shade and packed in white polythene bags and sealed. Formulation was stored at $27 \pm 2^\circ\text{C}$.

Enrichment of FYM

One hundred kg of fully decomposed farm yard manure (FYM) was spread out on the ground and a little amount

Table 1. Effect of seed priming with antagonistic fungi, rhizobacteria and soil amendments on wilt and yield attributing characters and yield of chickpea under field condition

Treatments	*No. of branches / plant	*Plant height (cm)	*Plant Biomass (q ha ⁻¹)	*Grain yield (q ha ⁻¹)	*Increase in yield over control (%)	*Cost-benefit ratio	* Wilt (%)
T ₁ = Seed priming with <i>Trichoderma viride</i> (Tv) @ 4g kg ⁻¹ seed	13.3	54.0	21.8	12.2	9.7	1: 12.2	26.0 (30.4)
T ₂ = Seed priming with <i>Pseudomonas fluorescens</i> (Ps. f.) @ 4g kg ⁻¹ seed	12.3	50.9	19.4	11.7	5.1	1: 3.4	28.4 (32.2)
T ₃ = Soil application of karanj oil cake @ 200kg ha ⁻¹	12.6	50.8	21.6	12.3	15.4	1: 2.9	22.9 (28.4)
T ₄ = Soil application of neem oil cake @ 250kg ha ⁻¹	12.8	50.6	22.6	13.0	17.6	1: 1.5	21.5 (27.5)
T ₅ = Seed priming with Tv @ 4g kg ⁻¹ seed and soil application of karanj oil cake @ 200kg ha ⁻¹	15.0	57.8	26.2	14.1	29.4	1: 4.8	18.1 (24.8)
T ₆ = Seed priming with Tv @ 4g kg ⁻¹ seed and soil application of neem oil cake @ 250kg ha ⁻¹	14.8	60.5	27.7	14.9	35.2	1: 2.7	15.6 (23.1)
T ₇ = Seed priming with P. f. @ 4g kg ⁻¹ seed and soil application of karanj oil cake @ 200kg ha ⁻¹	13.0	52.1	24.8	13.2	25.2	1: 4.0	19.8 (25.9)
T ₈ = Seed priming. with P. f. @ 4g kg ⁻¹ seed and soil application of neem oil cake @ 250kg ha ⁻¹	13.3	56.7	24.3	13.5	25.9	1: 1.9	20.3 (26.6)
T ₉ = Soil application of FYM @ 1.0ton ha ⁻¹ having Tv @ 1.0kg quintal ⁻¹ of FYM	13.5	55.4	26.0	13.8	26.4	1: 8.7	18.3 (25.4)
T ₁₀ = Soil application of FYM@ 1.0ton ha ⁻¹ having P. f. @ 1.0kg per quintal of FYM	12.9	51.0	21.8	12.5	17.9	1: 5.6	22.5 (28.1)
T ₁₁ = Control	11.5	47.9	19.1	10.9	-	-	59.0 (50.2)
CD (P = 0.05)	1.2	4.1	2.1	0.7	-	-	3.64
CV%	5.25	4.54	5.35	3.19	-	-	7.33

*Mean of three crop seasons data (2004-05, 2005-06 and 2006-07); figures in parentheses are transformed arc sine values; sale price of Chickpea Rs. 20 kg⁻¹; cost of karanj cake @ Rs. 5 kg⁻¹; neem cake @ Rs. 10 kg⁻¹; Tv @ Rs 140 kg⁻¹; Pf @ Rs. 160 kg⁻¹; labourer charge @ Rs. 73.00 / day / man; FYM @ Rs. 40 q⁻¹

of water was sprinkled over it. One kg of talc formulation of *T. viride* and *P. fluorescence* was uniformly sprinkled on the FYM separately and thoroughly mixed with a spade. The FYM was made into heaps and covered with a wetted jute bag and the heap of each was kept for 20 days with intermittent mixing. Water is sprinkled over it when required. After 20 days the FYM containing bioagents was ready to apply in the field.

Field trial

Chickpea seeds (*var.* - Pant G 114) were sown in 4.5m x 4.0m plots at 30cm x 10cm spacing. The trial was laid out in RBD with three replications. Sowing was done during the last week of October with seed rate of 75kg ha⁻¹. Recommended doses of fertilizers (NPK 20: 40: 20kg ha⁻¹) were applied at the time of sowing and the plots were irrigated, when required during the crop season. Observation of wilt incidences were recorded after appearance of disease and there after at weekly intervals, yield attributing characters, grain yield were also recorded. Dipel @ 1g lit⁻¹ water was sprayed to protect the crop from damage by fruit borer and other insects.

Wilt incidence

The results of the pooled analysis of wilt incidence data showed that the minimum wilt incidence of 15.6 percent was recorded in plots treated with seed priming with *T. viride* @ 4g kg⁻¹ seed plus soil application of Neem oil cake @ 250kg ha⁻¹. This treatment was at par with the treatments, seed priming with *T. viride* @ 4g kg⁻¹ seed plus soil application of karanj oil cake @ 200 kg ha⁻¹ and soil application of FYM @ 1.0t ha⁻¹ having *T. viride* @ 1.0kg q⁻¹ of FYM recorded wilt incidence of 18.1 and 18.3 per cent, respectively. The control plot recorded the maximum wilt incidence of 59.0 percent (Table-1) Bhat *et al.*, (2003) reported significant reduction of chickpea wilt by the seed treatment of *T. harzianum*. *Trichoderma* spp. have served as root protectant against soil borne pathogens by colonization, competition and antibiosis before infection of the pathogens. This may lead to control of chickpea wilt caused by *F. oxysporum* f. sp. *ciceri*, (Mukhopadhyay, 1994). Prasad *et al.*, (2002) found *Trichoderma* spp. seed treatment and soil amendment better than the fungicide seed treatment in controlling pigeon pea wilt.

Yield attributing characters

The results of pooled data revealed that seed priming with *T. viride* @ 4g kg⁻¹ seed plus soil application of neem oil cake @ 250kg ha⁻¹ recorded highest plant height of 60.5cm and number of branches per plant of 14.8 and highest plant biomass of 27.7q ha⁻¹. This treatment was at par with the treatment seed priming with *T. viride* @ 4g kg⁻¹ seed + soil

application of karanj oil cake @ 200kg ha⁻¹, recorded plant height of 57.8cm and no. of branches per plant of 15.0 and plant biomass of 26.2 q ha⁻¹.

This treatment was followed by soil application of FYM @ 1.0t ha⁻¹ having *T. viride* @ 1.0kg q⁻¹ of FYM, that recorded 13.5 branches per plant and plant height of 55.4cm and plant biomass of 26.0 q ha⁻¹. The control plot recorded 11.5 branches per 47.9 cm and 19.1q ha⁻¹ plant height of and plant biomass (Table 1). Similar results of increased vigor, shoot length, total biomass of chickpea by the application *T. viride* were also reported by Rudresh *et al.* (2005). Neelamegam (2005) also recorded that *T. viride* increases the tomato seed germination, seedling growth and vigor.

Grain yield and cost-benefit ratio

The results of pooled data revealed that the maximum grain yield of 14.9q ha⁻¹, was recorded by seed priming with *T. viride* @ 4g kg⁻¹ seed and soil application of neem oil cake @ 250kg ha⁻¹. The above treatment also recorded increase in yield over control of 35.2 per cent with cost benefit ratio (CBR) of Rs. 1: 2.7. This treatment was at par with the treatment, seed priming with *T. viride* @ 4g kg⁻¹ seed and soil application of karanj oil cake @ 200kg ha⁻¹ recording the grain yield of 14.1q ha⁻¹, increase in yield over control of 29.4 per cent with CBR of Rs. 1: 4.8. These treatments were followed by soil application of FYM @ 1.0t ha⁻¹ having *T. viride* @ 1kg q⁻¹ of FYM, recorded the grain yield of 13.8q ha⁻¹, increase in yield over control of 26.4 per cent with CBR of Rs. 1: 8.7. The control plot recorded the minimum grain yield of 10.9q ha⁻¹. Similar results were obtained in tomato by Neelamegam (2005). Organic amendments are excellent sources of nutrition which favour antagonist to proliferate and suppress the soil borne disease and also promotes chickpea grain yield. (Mukhopadhyay, 1994).

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