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Effect of soil solarization on chilli wilt caused by *Fusarium oxysporum* f.sp. *Capsici*

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ABSTRACT : An experiment was conducted to study the effect of soil solarization on chilli wilt, caused by *Fusarium oxysporum* f.sp. *capsici*. Transparent polythene sheets covered plots with different combination of irrigation and ploughing treatment for up to 4 weeks maintaining appropriate controls. It was observed that soil temperature at different soil depth *i.e.* 5 to 15 cm varied widely among different treatment and especially in the irrigated ploughed combination it had a maximum average of 51.0^{0}C compared to 39.8^{0}C in control. Soil population of *Foc* in irrigated ploughed treatment was reduced to non detectable levels.

KEY WORDS : Soil solarization, Chilli wilt, *Fusarium oxysporum* f.sp. *Capsici*

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Chilli is one of the most important commercial crops of India. It is grown almost throughout the country. There are more than 400 different varieties of chillie's found all over the world. It is also called as hot pepper, sweet pepper, bell pepper, etc. India is a major producer, consumer and exporter of chilli in the world. The major chilli growing states in India are Andhra Pradesh, Karnataka, Maharashtra, Odisha, Tamil Nadu, Bihar, Uttar Pradesh and Rajasthan. These states account for nearly 80 per cent area under chillies cultivation in India. Pungency in chillies is due to alkaloid capsaicin, which has good export potentiality. The red colour of chillies is due to the presence pigment capsanthin.

Chilli is a major source of income for poor farmers in India, but it suffers from many diseases, making it difficult to grow in hot humid conditions (The World Vegetable Centre in Asia). Chilli growers have, for many years, experienced considerable economic loss due to *Fusarium oxysporum*. In Leonian (1919) described a wilt disease of chilli caused by *Fusarium*. The symptoms of *Fusarium wilt* included leaf chlorosis, vascular discoloration, and wilting of chilli plants. High temperature and high moisture were conducive to symptom development of wilt (Sanogo, 2003).

Wilt disease caused by *Fusarium* is among major concerns in chilli in Nagpur district which was characterised by wilting of the plant and upward and inward rolling of the leaves. The leaves turn yellow and die. Generally appear localised areas of the field where a high percentage of the plants wilt and die, although scattered wilted plants may also occur. Disease symptoms are characterised by an initial slight yellowing of the foliage and wilting of the upper leaves that progress in a few days into a permanent wilt with the leaves still attached. By the time above - ground symptoms are evident, the vascular system of the plant is discoloured, particularly in the lower stem and roots. *Fusarium* is a soilborne fungus. Once a field is infested, the pathogen may survive in the soil for many years. The fungus can be transported by farm equipment, drainage water, wind, or animals, including humans. The fungus is seed and soil borne.Warmer and drier climates (>25^{0}C) favour disease and also when crop rotations are not practiced. *In vitro* culture showed pinkish white mycelium. Microconidia are formed singly, hyaline and cylindrical. Macro conidia are cylindrical to falcate. Chlamydospores are globose to oval and rough walled. Soil solarisation was evaluated in 2008 in chilli nursery which is a method of heating soil by covering it with clear, thin transparent polythene sheets during hot periods to control soil borne diseases. The technique has been commercially exploited for growing high value crops in diseased soil in environments with hot temperature.

RESEARCH PROCEDURE

The experiment was carried out during Oct., 2008 at Plant Pathology Section, College of Agriculture, Nagpur in Randomized Block Design with seven treatments *i.e.* irrigated plough, non - irrigated plough, irrigated without plough, non - irrigated without plough, *Trichoderma viride* (4g/kg), carbendazim (0.1%) and control and treatment were replicated three times. Each plot was 3 m × 1.5 m × 0.22 m (height) in size. As per design plough treatment was imposed by deep ploughing. Plots were irrigated to field capacity according to the design before they were coverd with transparent polythene sheets of 100µ thickness, burying and sealing along the edges with top soil, three beds in each replication were kept uncovered *i.e. Trichoderma viride* (4g/kg), carbendazim (0.1%) and control.

Isolation, identification and preparation of inoculum :

Diseased plants of chilli, were collected and the fungi, isolated were purified dilution plate single colony transfer technique. The fungal culture isolated were identified as *Fusarium oxysporum* f.sp. *capsici* (Foc). Potato dextrose agar (PDA) and *Fusarium* specific medium (Nash and Snyder, 1962) were used for preparation of inoculum.

Soil temperature :

Soil temperature from each bed at 5 cm, 10 cm and 15 cm depth were recorded daily at 14.30 hrs by using soil thermometer.

Quantitative estimation of *Fusarium oxysporum* f.sp *capsici* :

Soil samples from soil depth 0-5 cm, 5-10 cm, 10-15 cm were collected before and after solarization for quantitative estimation of soil borne pathogen.

$$\text{Per cent reduction} = \frac{B}{A} \times 100$$

where,

A = number of propagules per g soil after artificial inoculation.

B = number of propagules per g soil after solarization.

Plant growth parameter :

To asses whether solarization can control the occurrence of wilt, 300 seeds of NP 46 A, green chilli variety were line sowned in each bed on 05.11.2008 and observation on seed germination percentage, seedling mortality percentage and plant height (30 days after germination) were recorded to determine the effectiveness of soil solarization and compared to other management methods *i.e.* biocontrol and chemical control. Data were analyzed statistically as per the design.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under the following heads :

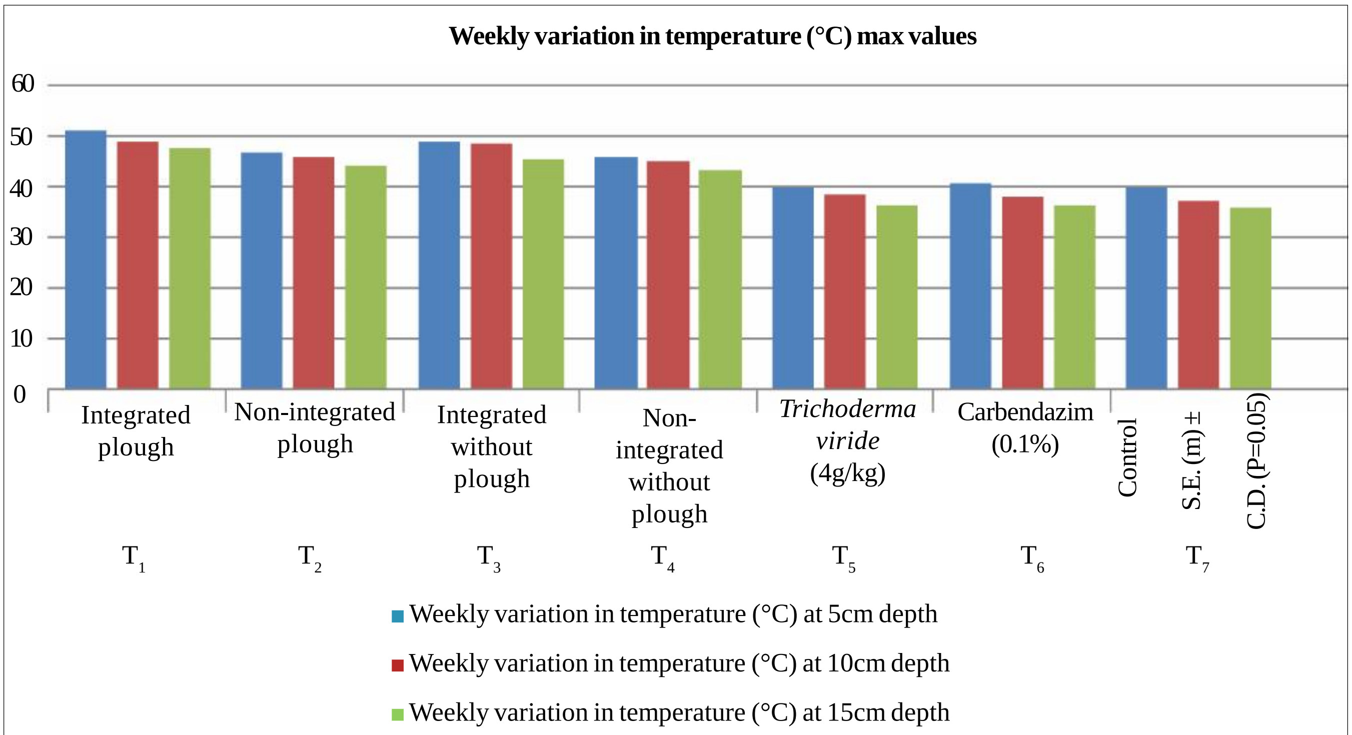

Fig. 1 : Weekly observations on soil temperature variation (^{0}C) at 5,10 and 15 cm depth

Effect of soil solarization on soil temperature in field :

Results revealed that mere covering of soil with polyethene sheet (*i.e.* non-irrigated without plough) raised the soil temperature by 4-8^{0}C at the depth of 0-15 cm than that of uncovered treatments. Irrigated without ploughing and non-irrigated ploughed treatments were also superior over control, they recorded temperature difference of 9-10^{0}C, and 5-8^{0}C, respectively over control, but the best results were recorded in irrigated plough, 10-12^{0}C. It may be attributed to the fact that irrigated soil promotes formation of more intense evapotranspiration which made solar radiation more intense and ploughing might have helped irrigation water to reach deeper layers which further helped in heating up of soil at deeper level (Fig. 1). Similar results were reported by Katan *et al.* (1976) and Chen and Katan (1980). Souzaa (1994), Sastry and Chattopadhyay (2001) and Pandey and Pandey (2004) showed that soil temperature at 5 cm depth under soil solarization varied widely and maximum of 52.5^{0}C was recorded in irrigated-ploughed-solarized combination than that of control, 44.4^{o}C .

Effect of soil solarization on *Fusarium oxysporum* f.sp. *capsici* population :

Results revealed that soil solarization reduced the population of *Fusarium oxysporum capsici* up to 0-15 cm depth by 51.6 to 76.3 per cent over control (34.6 to 39.3 %). Irrigated without plough and non-irrigated with plough also showed good results 63 to 88.3 per cent, 60 to 80.6 per cent; but the best results were shown by irrigated plough combination *i.e.* 76.6 to 90.0 per cent (Fig. 2). Similar results were reported by Hasegawa *et al.* (1988), Arora and Pandey (1989). Sastry and Chottopadhyay (1999) reported soil population of *Fusarium oxysporum* in irrigated ploughed treatment was reduced to non-detectable levels. Sharma *et al.* (2004) reported that *Fusarium solani* isolates were eliminated upto 30 cm soil depth after soil solarization.

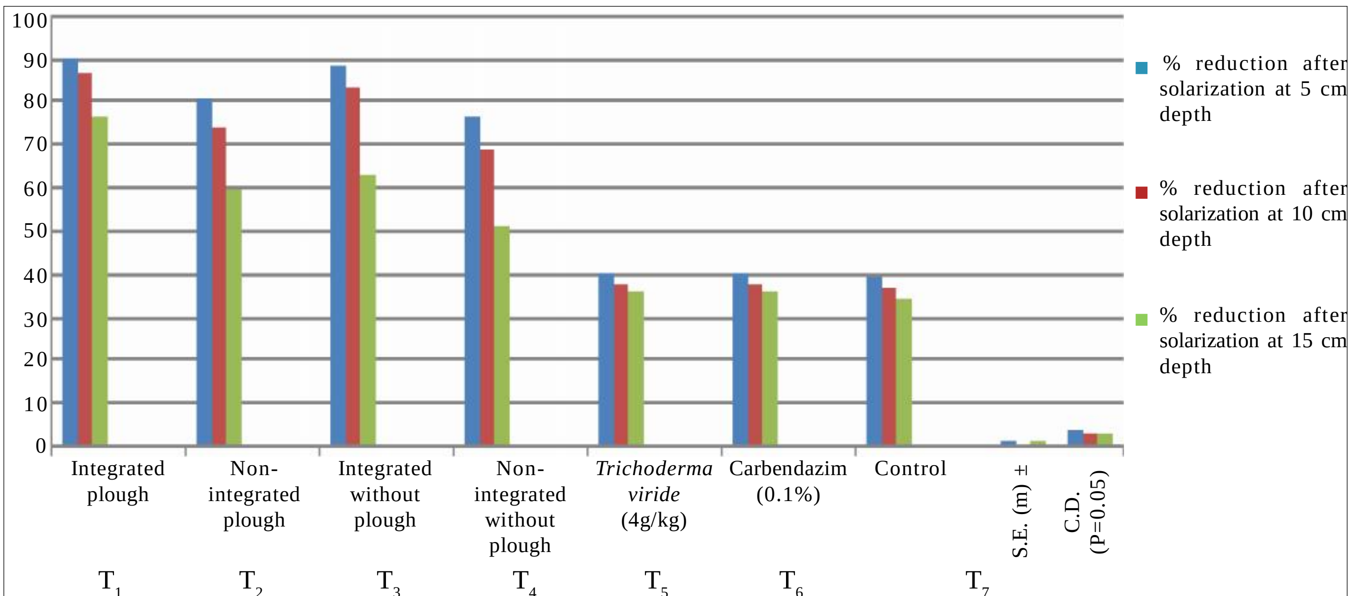

Fig. 2 : Effect of soil solarization on *Fusarium oxysporum* f.sp. *capsici* population

Table 1 : Effect of treatments on seed germination and seedling mortality percentage

Treatments no.	Treatments	Per cent germination	Per cent mortality	Plant height (cm), at 30 (DAG)
T_1	Irrigated plough	82 (64.88)	13.66 (21.65)	21.1
T_2	Non-irrigated plough	74.30 (59.58)	22.33 (28.18)	18.4
T_3	Irrigated without plough	77.60 (61.83)	19.00 (25.99)	19.4
T_4	Non-Irrigated without plough	70.00 (56.80)	25.33 (30.19)	18.3
T_5	Trichoderma viride (4g/kg)	75.00 (60.04)	21.60 (27.57)	19.8
T_6	Carbendazim (0.1%)	84.33 (66.74)	15.6 (23.26)	22.0
T_7	Control	43.00 (40.60)	52.30 (46.33)	11.0
	S.E. ±	1.27	2.21	1.49
	C.D. (P = 0.05)	3.92	4.81	4.57

Effect of treatments on seed germination, seedling mortality and plant height :

Results showed that seed treatment with carbendazim (0.1%) has highest seed germination percentage 84.33 per cent, which was found at par with irrigated plough 82 per cent (Table 1). Regarding mortality percentage of seedlings it is observed that all the treatment showed superior results than that of control. Most effective result showed by irrigated plough where 13.66 per cent mortality was noticed which was least among all the treatments and it was found at par with carbendazim (0.1%) 15.6 per cent. Maximum seedling height of 22.0 cm was found in carbendazim (0.1%) which was at par with irrigated plough (21.1 cm).

It can be concluded that solarization with irrigated plough treatment could be as effective as chemical or biological control in enhancing seed germination, reducing the mortality percentage and increasing plant height. Effective disease control is correlated with corresponding reduction in soil-borne pathogen species such as *Fusarium oxysporum* (Katan *et al.,* 1976 ; Stapleton and Devay, 1986; Egley (1983) and Sharma *et al.,* 2004).

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