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SOIL SOLARIZATION FOR GROWTH ATTRIBUTES AND WEED CONTROL IN TOMATO NURSERY

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ABSTRACT

The investigation was carried out in a farmer's field, to study the effect of solarization on growth of tomato seedlings and weed management in nursery. The experiment was laid out in randomized block design with 11 treatments, each replicated thrice. The treatments include a combination of solarization for four weeks after incorporation organic manures viz., vermicompost, FYM, neem cake and castor cake along with non solarized control and solarization without amendments. Inoculation of *Azospirillum* was done in some treatments to bring in liveliness after solarization.The highest germination percentage, number of leaves, chlorophyll content, vigour index , days taken for transplanting, lowest weed population, weed biomass and highest weed control index were registered in the treatment where solarization with vermicompost was carried out.

Key words: Solarization, Tomato vigour index, Tomato Weed population, *Azospirillum* and Organic manures.

1. Introduction

Tomato (*Solanum lycopersicum L.)* is an important cash earning vegetable crop of small farmers. It also tops the listof industrial crops because of its outstanding processing qualities. Tomato cultivation extends over an area of 7.6 lakh ha with 18.39 MT annual production in India . Indiscriminate use of chemical fertilizers, pesticides and herbicides has led to the deterioration of soil health, ground water quality, soil microbial population, atmospheric constituents, quality of the agricultural produce and thereby the health of animals and humans. Being a transplanted crop, vigorous and healthy seedlings from the nursery ensures better establishment in the field and ultimately has a bearing on the yield and quality attributes of tomato. Damping off disease, plant parasitic nematodes and weeds are often transmitted through soil amendments, transplants and nursery stock. Nursery care focuses mainly on the prevention of weed growth and offering protection against soil borne pests and pathogens. Artificial soil heating or soil solarization is the only non chemical soil disinfestation method which has been tested on a large scale under farming conditions. Combining organic amendments with soil solarization is a developmental approach in an integrated farming system (Jeffschalan, 2003).

2. Materials and Methods

The experiment was laid out in randomized block design with 11 treatments replicated thrice. The treatments include a combination of solarization for four weeks with and without *Azospirillum* inoculation and four different organic manures viz., Vermicompost, Farm Yard Manure (FYM), Neem cake and castor cake along with non solarized control and solarization without organic manure. The dosage of organic manure used was 1 kg m2.

The organic amendments were incorporated thoroughly into the soil according to the respective treatments. After incorporation of the organic manures, the nursery beds of size 3m x 1 m were formed. Then, the beds were irrigated to field capacity to encourage exothermic fermentation process. After irrigation, the beds were covered with the high density poly ethylene sheet of 300 guage thickness and the sides were tucked into the soil. The plots were solarized for a period of four weeks and monitored carefully. After the solarization period was over, the polyethylene sheets were removed. Two days later, *Azospirillum* was inoculated in respective beds when seeds were sown.

3. Results and Discussion

One of the objectives in doing solarization is to provide adequate weed control in most of the freshly consumed vegetables (Standifer *et al*., 1984). Solarization with and without amendments produced two different complementary effects like foliar scorching of emerged plants under plastic cover and decreased weed emergence after removing the plastic sheets. This residual effect on weeds was considered as the principal benefit of the treatment. In this investigation, solarization with vermicompost followed by neem cake suppressed the weed population at higher level (Table - 1). The excess heat generated during the period of solarization with vermicompost might have contributed for suppressing germination of weed seeds as well as vegetative structures present in the upper layer of the soil. Studies by Herdricks and Taylorson (1976), revealed that heating weed seeds from 30 to 35 °C modified the membrane permeability, which resulted in leakage of endogenous amino acid and simultaneous reduction in germination rate. In the present study also, the highest level of soil temperature attained over control in all days of observation resulted in efficient suppression of weed growth though not in complete elimination as reported earlier by Abu-Irmaileh (1991).

The effect of solarization with amendments in reducing the dry weight of weeds was almost similar to that in reducing the weed count. Specific environmental conditions such as light, temperature, carbon-di-oxide, oxygen and other volatile compounds in the soil controls the process of weed seed germination (Rubin and Benjamin, 1984; Ricardo Antonio Marenco and Denise Castro lustosa, 2000) Hence, seeds located at a soil depth where the prevailing conditions due to solarization are not favourable for germination may remain dormant, but viable until the conditions change. However, when the temperature increases, seeds may die or otherwise increase in temperature in the deep layers probably may not be high enough to be lethal, but significant to break the dormancy and force the germination. Changes in carbon-di-oxide oxygen levels in soil under polyethylene mulch may also play an important role in partial or complete breaking of seed dormancy thus enhancing germination. Thus, during their emergence, the seedlings were killed by the temperature of hot upper layer.

Due to reduction in weed population and weed dry weight, there was considerable increase in the weed control index. In comparison with non solarized control and solarization without amendments, the highest weed control index was achieved in the treatment solarization with vermicompost followed by neem cake. Weed emergence after solarization to a greater extent was the function of weed seed tolerance to solar heating. Levitt (1980) reported that the dry weeds are resistant to higher temperatures (120°C) whereas the hydrated ones are killed at even lower temperature (<50 °C). It was suggested that in the presence of water, less energy was required to damage the peptide chain configuration of proteins, resulting in reduced heat resistance (Katan, 1981). The process of solar weed control, according to Jacobson *et al*. (1980) involves biological process in addition to physical process which occur when soil temperature is raised, as discussed earlier (i.e.) sub-lethal temperature may weaken the resting structures, thus rendering them more vulnerable to antagonists in the soil.

The present investigation in nursery solarization with amendments on the performance of tomato seedlings revealed that the germination as well as initial growth of seedlings including seedling vigour was enhanced by the different solarization treatments with amendments. Among the various amendments, solarization with vermicompost and post solarization treatments with *Azospirillium* recorded the highest germination percent , shoot and root length followed by solarization with vermicompost alone. This could be compared to solarization with neemcake and *Azospirillium*. The improved germination could be attributed to the congenial surroundings in the top layer of the soil which was amended as well as solarized. The favorable effect on seedling emergence may also be attributed to the secretion of growth acceleration substances such as Indole Acetic acid, Giberrlic acid and cytokinin produced by *Azospirillium* (Tien *et al*., 1979). The destruction of harmful micro organisms like the spores of fungi , bacteria actinomycetes and nematodes by the population of bio toxic volatiles might have also helped in the better growth as well as initial shoot and root length . The seedling vigour as expressed by the vigour index was also considerably high in vermicompost and *Azosprillium* treated beds followed by solarization with vermicompost alone. This was comparable with solarization with Neem cake +*Azosprillium* (Table.2) This might be attributed to the reduction in the competition between the seedlings and the weeds that have been destroyed. This is in concordance with the findings of stevens *et al*.(2003) in nursery for vegetable crops. The better physiological status of the seedling s was also identified by the higher level of chlorophyll content and the number of leaves in the seedlings . All these factors put together made the seedlings attain the transplantable stage in these treatments well ahead of the seedlings raised in the other treatments. While development of favourable environment facilitated the plants to absorb more nutrients ,the elimination of unfavourable factors also counts a lot in the growth and development of crops plants Abdallah *et al*.(2004).

4. References

1. Abu- Irmaileh, B. E. 1991. Weed control in squash and tomato fields by soil solarization in the Jordan Valley. Weed Research, 31: 125 -.133.
2. Abdallah, M.M.F., S.A.EI. Hadad and M.M.Satour 2004. Effect of seed bed Solarizatron on Cabbage and lettuce transplants Quality. The FAO / ARC IPM Project GLP/SUS/026NET.
3. Herdricks, S. B. and R. B. Taylorson. 1976. Variation in germination and amino acid leakage of seeds with temperature related to membrane phase change. Plant Physiology, 58:7- 11.
4. Jacobson, R., A. Greenberger, J. Katan, M. Levi and H. Alon. 1980. Control of Egyptian Broop rape and other weeds by means of solar heating of soil by polythene mulching. Weed Science, 28:312-318.
5. Jeffschalan, K. 2003. Soil solarization. Backyard gardener.
6. Katan, J. 1981. Solar heating (Solarization) of soil for control of soil borne pest. Annual Reviews in Phytopathology, 19: 211 - 236.
7. Levitt, J. 1980. Response of plants to environmental stresses, Volume - I, Academic Press, New York, pp: 520.
8. Ricardo Nantonio Marenco and Denise Castro Lustosa, 2000. Soil solarization for weed control in carrot, Pesq. Agropee. Bras, Brasilia, v-35, n.10, p:2025-2032.
9. Rubin, B and A. Benjamin. 1984. Solar heating of soil: Involvement of environmental factors in the weed control process. Weed Science, 32: 138 - 142.
10. Standifer, L. C., P. W. Wilson and R. P. Sorbert. 1984. Effect of soil solarization on soil weed seed population. Weed Science, 32: 569-573.
11. Stevens, C., V.A.Khan, R.Rodrigvez-Kabuma, I.D. Phoper, P.A., Backman, D.J.Collins, J.E.Brown, M.A.Wilson and E.C.K. lgwegde.2003. Integration of soil solarization with chemical, brological and cultural for the managment of soil borne diseases of Vegetalbes. Plant and soil, 253:493-6
12. Tien, T.M.,M.H. Gookers and D.H.Hubbell 1979 Plaomt growth sybstances produced by Azos pirillium brasilienze and their effect on the growth of pearl millet (Pennisitum ameri lanuraL.). App. Envir. Microbiol., 37:1016-1024.

Table — 1: Effect of solarization of tomato nursery with different organic amendments on weed population, weed dry weight and weed control index at the time of transplanting

Treatments		Weed Population* m^{-2}	Weed dry weight* $g\ m^{-2}$	Weed Control Index**
T1	Non solarized control	(79.82) 8.91	(38.63) 6.26	-
T2	Solarization without amendments	(22.96) 4.84	(11.62) 3.48	(69.92) 56.74
T3	Solarization with Castor Cake	(14.39) 3.86	(7.21) 2.78	(81.34) 64.41
T4	Solarization with Neem cake	(11.02) 3.39	(5.88) 2.53	(84.78) 67.04
T5	Solarization with Vermicompost	(8.32) 2.96	(4.63) 2.26	(88.01) 69.74
T6	Solarization with Poultry Manure	(17.49) 4.24	(9.31) 3.13	(76.00) 60.67
T7	Solarization with Castor Cake + *Azospirillum*	(17.11) 4.16	(9.01) 3.08	(76.68) 61.12
T8	Solarization with Neem Cake + *Azospirillum.*	(14.08) 3.82	(7.00) 2.74	(81.88) 64.81
T9	Solarization with vermicompost + *Azospirillum*	(11.37) 3.45	(6.00) 2.55	(84.47) 66.79
T10	Solarization with Poultry Manure + *Azospirillum*	(20.22) 4.55	(10.24) 3.28	(73.49) 59.01
T11	Solarization without amendments + *Azospirillum*	(25.71) 5.11	(12.48) 3.60	(67.69) 55.36
S. Ed.		0.13	0.06	1.23
CD (p = 0.05)		0.25	0.12	2.46

Figures in parentheses indicates original value

* Data are square root transformed values $\sqrt{(x + 0.5)}$
* *Data are arc sin transformed values

Table 2.Effect of nursery solarization with amendments on growth attributes of tomato seedlings

Treatments	Germination (%)	Short length (cm)	Root length (cm)	Number of leaves	Chlorophyll content(mg g^{-1})	Vigour index	Days taken for transplanting
T_1- non solarized control	(79.98)64.42	16.21	4.28	7.09	1.01	1578.83	47.01
T_2- solarization without amendments	(83.10)66.73	17.45	4.83	7.53	1.03	1785.27	43.64
T_3- solarization with Castor cake	(89.74)72.32	20.01	5.81	8.32	1.10	2237.61	37.86
T_4- solarization with Neem cake	(91.89)74.45	20.92	6.14	8.59	1.12	2402.76	35.76
T_5- solarization with Vermicompost	(94.07)76.91	21.79	6.46	8.85	1.14	2569.34	33.87
T_6- solarization with poultry manure	(87.32)70.14	19.12	5.49	8.05	1.07	2074.31	39.88
T_7- solarization with Castor cake + Azos	(91.84)74.40	20.89	6.13	8.58	1.12	2397.84	35.98
T_8- solarization with Neem cake+ Azos	(93.99)76.81	21.72	6.45	8.84	1.14	2559.72	33.89
T_9- solarization with Vermicompost+ Azos	(96.08)79.59	22.82	6.78	9.11	1.16	2751.81	32.00
T_{10}- solarization with poultry manure + Azos	(89.62)72.21	19.99	5.80	8.31	1.10	2232.06	37.99
T_{11}- solarization without amendments+ Azos	(85.00)68.21	18.27	5.16	7.80	1.05	1921.55	41.76
SED	0.96	0.39	0.15	0.12	0.005	69.52	0.91
CD(P=0.05)	1.92	0.79	0.30	0.25	0.01	139.74	1.82

Figures in parentheses indicates original value

* Data are square root transformed values $\sqrt{(x + 0.5)}$ * *Data are arc sin transformed values