

EFFECT OF ADDING INORGANIC, ORGANIC AND MICROBIAL FERTILIZERS ON SEED GERMINATION AND SEEDLING GROWTH OF SUNFLOWER

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Abstract

In a comparison made on the effect of adding inorganic, organic and microbial fertilizers in soil on the germination of seeds of 4 sunflower varieties viz., Hysun-33, Hysun-38, Helico-250 and SA-278 it was found that manure and triple phosphate had good effect as compared to the control series. Inoculation of microbial fertiliser (VAM-fungal spores) had no effect for 6 days and the percentage of germination of seeds was equal to the control series. On the emergence of seedlings there was a better seedling growth in VAM-fungi inoculated plants as compared to organic manure and inorganic triple phosphate fertilisers. Addition of 300 mg/kg of manure and triple phosphate showed better increase in growth and fresh and dry weights over the control. Addition of 500 mg/kg of manure and triple phosphate in soil showed lodging of seedlings. Inoculation of 500 spores/kg in soil showed remarkable effect on the growth of seedlings after 15 days and there was no lodging of seedlings. The increase in growth was due to the establishment of symbiotic association between the VAM-fungi in roots of sunflower plants which was evident under microscope.

Introduction

Pakistan is deficient in edible oil and 65% of its requirement is met by importing palm oil and soybean oil at the cost of \$ 1.5 billion. The domestic production of sunflower (*Helianthus annuus* L.) oil is 13.4% (Shah *et al.*, 2005). Farmers in Pakistan cultivate sunflower both as Rabi (winter) and Kharif (summer) crop. Sunflower is cultivated in summer as it has been found to be more or less drought resistant (Meo *et al.*, 2000). For the establishment of a good crop stand, uniform and maximum germination of seeds and emergence of strong and sturdy seedlings are necessary as they are able to survive under stressed condition. Hypogeal and epigeal germination is a process in which seeds imbibe water, trigger respiration resulting in radicle formation and emergence of plumule. For a better germination and growth of plants, fertile soil is necessary. Inorganic or organic fertilizer is added in the soil to increase the fertility of soil. Now there is a great deal of experimental backing that mycorrhizal symbiosis promotes plant growth (Raja, 2006). Colonization of plant roots by mycorrhizal fungi greatly enhance the uptake of phosphorus and other nutrients (Chen *et al.*, 2005). The seedling growth stages are the part of plants life when it is at greatest risk and when mycorrhizas are of greatest importance. This study was undertaken to find out the effect of adding various doses of inorganic (triple phosphate), organic (manure) and inoculation of microbial (VAM-spores) fertilizers on the seed germination and seedling growth stages of sunflower.

Materials and Methods

Sandy-clay loam soil from Karachi University Campus with moisture content of 10% as determined by Keen & Rackowski (1921) and pH of the soil at 7.5 determined electrometrically was put in a series of earthenware pots, each pot with 5 kg of the soil. Seeds of sunflower vars. Hysun-33, Hysun-38, Helico-250 and SA-278 dressed with methyl thiophenate (Topsin) to resist soil-borne diseases were sown separately in a series of replicate pots. Three different doses of inorganic fertiliser (triple phosphate), organic fertilizer (cow dung manure) and spores of VAM (Vesicular-arbuscular mycorrhizal) fungi extracted by wet sieving and decanting (Gerdemann

& Nicolson, 1963) from the rhizospheric region of sunflower were maintained as soil-based culture in laboratory at 10°C. The VAM-spores culture was in the form of mixture of different species of *Acaulospora rugosa*, *Glomus callosum*, *G. fasciculatum*, *Gigaspora albida* and *Scutellispora auriglobosa* identified earlier on the basis of morphological and anatomical characteristics as described in the Manual for the identification of VA-fungi by Schenck & Perez (1990). Three replicate series of soil pots were inoculated with the four sunflower vars. before sowing seeds for symbiotic relationship between the VAM-fungi and roots of sunflower. Three different doses of each of the inorganic (triple phosphate), organic fertilizer (manure) were added @ 100, 300 and 500 mg/kg of soil. The inoculation of 100, 300 and 500 spores as low, medium and high doses per kg of soil were used. For determining the effect of spore inoculation, mycorrhizal infection in roots of sunflower seedlings by the staining method of Phillips & Hayman (1970) was followed. A replicate series of pots were left unamended and uninoculated as control. The pots were left in the open and watered to keep the soil moist. The data on germination of seeds and growth of seedlings on adding fertilizers and inoculating VAM-spores at different stages of seedling growth from the surface of soil up to the terminal buds of the seedlings were recorded for 21 days.

Results and Discussion

The results on the germination of seeds of sunflower showed that addition of triple phosphate and manure in soil @ 300 mg/kg of soil had better germination rate and was highest at 500 mg/kg. Inoculation of spores of VAM-fungi @ 100, 300 and 500 spores as soil based VAM cultures did not promote the rate of germination and the rate of germination was equal to the control series. However, after 12 days of VAM-fungal inoculation there was a marked epigeal germination and in seedling growth stage (Fig. 1). Microscopic examination of sunflower roots after 15 days of sowing of seeds showed infection of roots by the VAM-fungi and formation of mycelial strands vesicles and arbuscules in the cortical cells of roots under microscope (Fig. 2). The mycelial strands and arbuscules were also found in roots when seeds were sown in soil with organic fertilizer (manure). The manure examined under microscope by means of dilution series

was invariably found to contain 14 to 15 VAM spores per gram of soil. This explains the reason for a better seed germination rate in soil added with manure as compared to the control series. Addition of triple phosphate in soil pots promoted seed germination and growth of seedlings. There was a little difference in the rate of germination and growth of seedlings in between the amendments of triple phosphate and VAM-inoculation. This difference is considered to be due the time taken by the VAM spores to interact with insoluble phosphate compounds to release

locked up phosphorus into available form (Illemer & Schinner, 1992). The method of Menge & Timmer (1992) can be adopted for inoculation of plants with vesicular-arbuscular mycorrhizae in the laboratory, greenhouse and in farm fields. Since phosphatic rocks are imported in Pakistan for addition in soil to increase its fertility, it would be prudent to inoculate VAM-fungi for the transformation of unavailable form of phosphorus locked up in soil as phytate into available form.

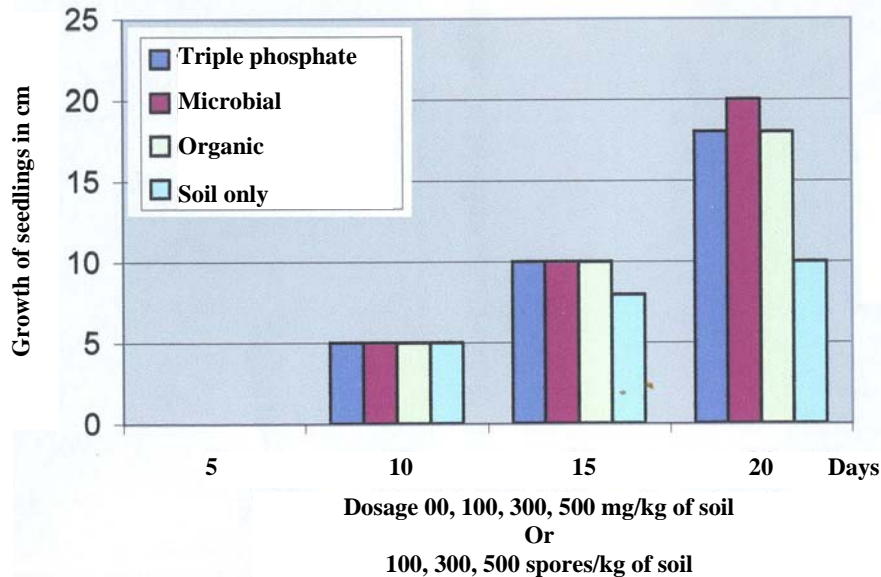


Fig. 1. Effect of adding inorganic (triple phosphate) organic manure), and microbial (VAM-fungi) fertilizers in sunflower soil pots.

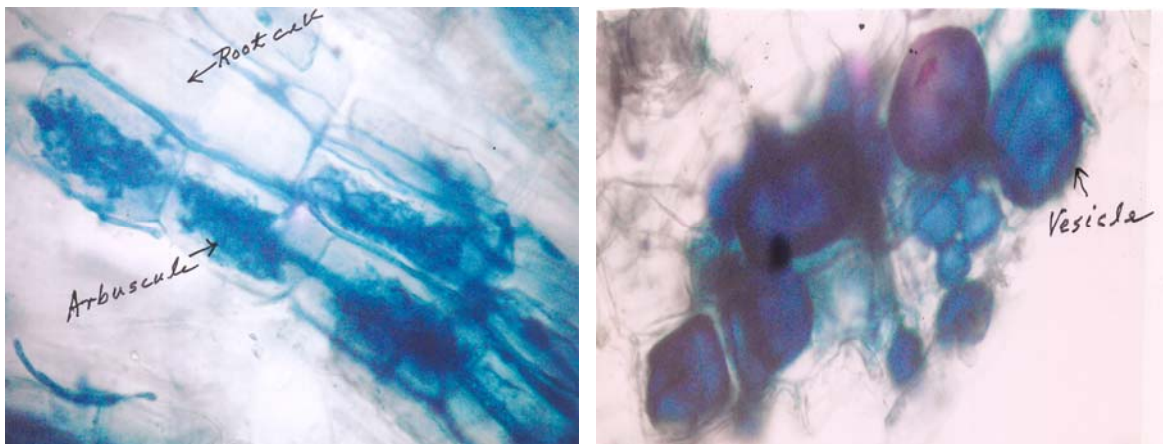


Fig. 2. Mycorrhizal vesicles and arbuscules seen inside the cortical tissues of sunflower roots on staining under microscope.

From the result on addition of fertilizers in soil (Fig. 1) it would be clear that addition of organic fertiliser (manure) @ 500 mg/kg of soil and inorganic fertiliser (triple phosphate) @ 500 mg/kg of soil had enhanced the growth stages of sunflower seedlings but the high cost of fertilizers is a hindrance for the farmers to make costly input. The addition of either organic fertiliser (manure) or inorganic fertiliser (triple phosphate) should not exceed beyond 300 mg/kg in calcareous-clay loam soil mostly found under natural condition in Sindh (Pakistan). Of the

four varieties of sunflower (Hysun-33, Hysun-38, Helico-250 and SA-278), Hysun-33 had the best effect on the growth of sunflower seedlings on the addition of organic, inorganic fertilisers and on the inoculation of VAM spores (Fig. 1). The VAM-fungal spores are naturally present in soil which can be managed for mass inoculation (Siverding, 1991). It is a proven fact that there are benefits of mycorrhizal inoculation in soil (Crews *et al.*, 1978; Bolan, 1991). Therefore, it would be advisable to cultivate sunflower var. Hysun-33 in farmlands of Sindh in

preference to the other 3 vars. of sunflower. It is concluded that the dose of organic fertiliser (manure) and inorganic fertiliser (triple phosphate) may not be added @ more than 300 mg/kg of soil to make the use of fertilisers cost effective. Inoculation of microbial fertilizer should be introduced and extension farm field agriculturists should be trained for mycorrhizal propagation and inoculation. This research was carried out with the funding facility of the Higher Education Pakistan which is gratefully acknowledged.

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