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Research Notes

Phosphorus uptake and growth of maize as influenced by fumigan application

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The lateritic soils of eastern India are P deficient due to rapid fixation of applied P by Al/Fe. To alleviate the problem of P deficiency, one is required to apply large amount of P fertilizer to these soils. Therefore, it becomes important to search for a crop, which is capable of exploiting fixed P from the soil. This may be possible if crop adopts a strategy of modifying root morphology to shoots off more root hairs to increase nutrient absorbing area or chemical mobilization of soil P. The symbiosis between plants and Vesicular Arbuscular Mycorrhiza (VAM) increases plant performance in soils of low P status. Tinker (1975) and Young *et al.* (1986) showed that VAM fungi in association with plant roots increased the phosphorus uptake in deficient soils. Abbot *et al.* (1979) observed that positive growth response to VAM inoculation is usually related to increased phosphorus uptake. Maize, has considerably benefited from mycorrhizal association (Omar, 1995). If mycorrhizal infection is beneficial to plants under field conditions and if this benefit derives from increased phosphorus uptake, then removal or reduction of VAM infection should result in decreased levels of phosphorus in the plant. Benomyl (a fumigant) has been widely used to reduce or eliminate mycorrhizal infection. Since culturing of VAM at mass scale is a difficult task, the main aim of this experiment was to study the contribution of native VAM on growth and P uptake by maize under field condition. The fumigant benomyl can be applied to the soil in half of the plots to obtain plants with reduced mycorrhiza formation. Since, it was not known the exact amount of Benomyl needed to eradicate or reduce VAM infection, a pot experiment was designed to find out the quantity of Benomyl required in reducing the VAM infection of maize.

For the present pot experiment benomyl was applied to the soil at the rate of 0 (no benomyl applied), 100, 200, 400 and 600 kg ha^{-1} by mixing with the soil. Nitrogen and Phosphorus were applied to all pots by mixing at the rate of 100 kg ha^{-1}, and 40 kg ha^{-1} in the form of urea and muriate of potash respectively. Micronutrients Ca, Mg, Zn, B, Mo and Cu were applied to all the pots at the rate of 1.0 mg kg^{-1}, 1.0 mg kg^{-1}, 0.5 mg kg^{-1}, 0.5 mg kg^{-1}, 0.5 mg kg^{-1} and 0.5 mg kg^{-1} respectively. The experiment was conducted in the glass house conditions for the crop maize (hybrid variety-DHM 103). There were five treatments and each replicated four times. Maize plants were allowed to grow till the maximum growth period. The pots were watered to maintain a water content near the field capacity. Four harvests were made and at each harvest, shoot dry weight, shoot P content, root length, and percentage root infected by VAM were determined by following standard methods.

The shoot dry weight of maize recorded at different harvests for various benomyl levels is shown (Fig.1a). The shoot yield increased linearly with the advancement of plant age and decreased with increasing levels of benomyl. The shoot yield at B-0 continued to remain higher than all other benomyl treatments through out the growth period. After 30 days of growth, the reduction of shoot yield was 5% at B-100 and it was 13% at B-600 thus showing the effect of benomyl application. Similarly, at 90 days after sowing, growth reduction was 5% at B-100 and 23% at B-600. A significant reduction in shoot yield at B-600 was not because of harmful effect of benomyl but was because of reduced root length and P uptake at B-600 (Fig. 1b and 1c). The increase in plant growth at B-0 treatment may be attributed to association of VAM, which increases the absorption of nutrients from the soil. Root length is another important parameter which influences nutrient uptake as the nutrient absorbing root surface area depends up on the length of the roots. Root length increased strongly

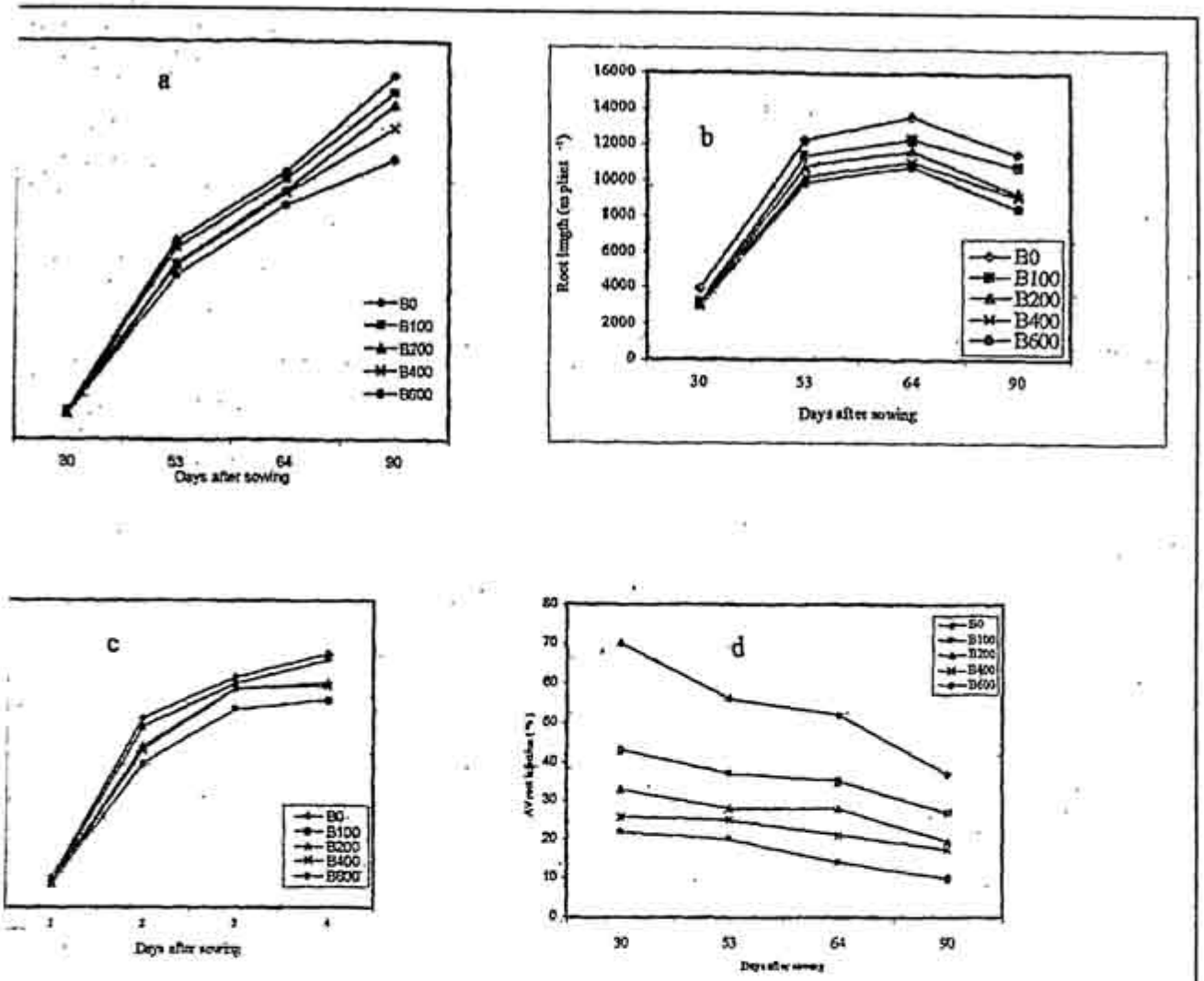

Fig 1. a) Shoot dry weight, b) Root length, c) Phosphorus uptake and d) Root infection of maize as influenced by Benomyl levels

o the middle of the season and thereafter ıt length declined with the increase of plant ɜ (Fig.1b). The root length responded to ıomyl application by decreased total root ıght (similar to shoot yield). Irrespective of ınt age, the root length reduced by about % at B-100 to 26% at B-600, compared B-0 treatment. The percentage root infected VAM at different benomyl levels for different rvests is shown in (Fig. 1d). An extensive ıM colonization of upto 75% of the root ıgth was established in untreated soil -0). Root infection by VAM reduced more ongly by fumigation at high levels but there s been little variation in root infection with ɜ advancement of plant age except at B- were infection declined appreciably from 75% first to 45% at final harvest. The figure rther shows that benomyl applied @ 600 kg ha^{-1} markedly decreased VAM infection to the extent of 10 per cent. The shoot P uptake was decreased by benomyl application at all the harvests (Fig. 1c). The effect of VAM on the growth of host plants in pot-culture experiments using sterile soil has shown that phosphorus uptake per unit root length is typically enhanced by infection. Though the P uptake decreased with increasing levels of benomyl, there were no significant differences among the treatment, except at B-600 where uptake declined significantly compared to B-0 or B-100. The effect of fumigation on P uptake is ascribed to the suppression of mycorrhiza formation. A symbiotic association between VAM and crop plants is well known to increase the capacity of roots to extract nutrients and water from even infertile soils (Gerdemann, 1976). Increased phosphorus uptake is the most obvious

benefit of VAM colonization having been demonstrated in many native and agriculture plants (O'Keefe and Sylvia, 1990).

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Research Notes

Efficiency of traditional jaggery making furnace

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At village level small-scale cottage industries, jaggery making is done using juice obtained after crushing sugarcane at the site with a crusher. The bagasse left after crushing is sun dried in open yard for reducing the moisture content and used as fuel in the furnace for jaggery making. A study was conducted to evaluate the overall heat utilization efficiency of these furnaces.

A typical jaggery making furnace consists of fuel feeding, opening, grate, fire place, chimney and ash chamber. It is constructed with brick and mud below the ground level. The smoke produced during combustion is made to go out through a chimney of the oven. The bagasse is fed continuously through the fuel feed opening manually at regular interval of time. The sugarcane juice is kept in a GI vessel of 660 litre capacity placed over the fire place and boiled.

In order to evaluate the system performance of the jaggery making furnace, various details such as the juice recovery obtained after crushing sugarcane, amount of bagasse obtained, the moisture content before and after sun drying, the amou and frequency of feeding bagasse into the ove were noted. The temperature of juice durin boiling and the temperature of smoke wer also observed. Fourteen jaggery making furnace owned by farmers who manufacture jagger locally were inspected and all the above dat were collected.

The study revealed that 650 kg of juic and 350 kg of bagasse (50% M.C., wb) wer obtained from one tonne of sugarcane crushe The bagasse was sun dried to bring down th moisture from 50% to 20% (wb) and aft drying, 245-250 kg was obtained from 35 kg bagasse. The observations indicated that 65 kg of juice was boiled per batch to get 13 kg of jaggery. In the above process, 500 k of water was evaporated from juice and 2 kg of slag (mud) was removed while boilin The bagasse required per batch was about 50 kg which cannot be met from one tonne c bagasse crushed in one batch. So 250 kg c additional bagasse or any other fuel was require for one batch. This requirement is as met b