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EFFECT OF POLYMERS ON GERMINATION, PLANT HEIGHT AND PERMANENT WILTING POINT OF MAIZE (*ZEA MAYS* L) AND SOYBEAN (*GLYCINE*) *MAX*

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The study was conducted on sand and clay loam soils in the laboratory to evaluate the influence of soil conditioners on crop characteristics. Organic manure (farm yard manure), aquasorb and terrasorb were tested at 0.5 and 1% lvels. Maize (*Zea mays* L) and soybean (*Glycine max*) crops were grown. The highest germination of maize and soybean was in 1% treated sand. The response of maize seed germination in clay loam was lower compared to that of sand. Emergence of maize was more compared with that of soybean on clay loam. The height of maize plants was greatest in 1% aquasorb-treated clay loam soil whereas height of soybean plants was greatest in 1% terresorb treatment. The polymer treatment gave a significatnly greater height of plants on clay loam than on sand. Longest duration of maize plants survival was in 1% aquasorb-treated clay laom (16.3 days). Soybean seedlings survived for a maximum period of 30 days and 39 days in 1% aquasorb-treated sand and 1% aquasorb-treated clay loam soils, respectively. In summary, the polymers had a marked influence on increasing germination, plant height and survival of both maize and soybean on sand and clay loam soils.

Introduction

Crop production is chiefly dependent on ecological and soil conditions. Moisture stress is a major constraint to crop growth in arid and semi arid regions as the precipitation is low and uncertain in these areas. Efficient utilization of meager soil and water resources necessitates the adaptation of appropriate water management techniques. Soil conditioners have been reported to be effective tools in increasing water holding capacity, reducing infiltration rate and cummulative evaporation and improving water conservation of sandy soils [1-3]. Gupta *et al.* [4] found 100% increase in moisture retention by the application of soil conditioners. Pritchard and Quinn (n.d) stated that terrasorb increases crop yield, reduces water losses and conserves water. Soil conditioners have been found to increase emergence and dry weights of seedlings of tomato, cotton and lettuce [5]. Cross linked polyacrylamides are used as soil conditioners where short term or persistent drought inhibits plant growth [6]. Keeping in veiw the miraculous importance of polymers, the study was undertaken to evaluate the influence of soil conditioners on various crop characteristics.

Materials and Methods

The study was carried out in 1990 on sand and clay loam soils in the laboratory having 15 and 35% water saturation respectively. The pH was 7.8 in both cases. Five hundred grams of air dried soil passed through a 2 mm sieve was filled in 1000 ml beakers. The diameter of the beaker was 10 cm and the depth of soil was 4.6 cm in the beakers. Fertilizer was added at a rate of 75 kg N and 22 kg P per hectare (ha^{-1}) in the form of urea and diammonium phosphate (DAP) respectively in solution form. Organic manure (farm yard manure), aquasorb and terrasorb (both synthetic soil conditioners) were mixed into the soil and the treatments used were : Control (T_1), 0.5% organic manure (T_2), 1% organic manure (T_3), 0.5% aquasorb (T_4), 1% aquasorb (T_5), 0.5% terrasorb (T_6) and 1% terrasorb (T_7).

The experiment was replicated three times. Distilled water (150 ml) was added into each beaker and maize crop was planted on April 24 (8 seeds). First irrigation was applied on May 2. Thereafter, the survival of plants was observed in terms of days after irrigation.

After the death of all maize plants, 150 ml of distilled water was again added into each beaker on June 4 and soybean seeds were planted on June 18 (8 seeds). Subsequently three irrigations of the same quantity were applied on June 20, June 27 and July 2. Plant height was recorded on July 8 and the time of survival of plants was recorded in different treatments after the last irrigation. The data were subjected to analysis of variance (ANOVA) and the least significant differences (LSD, P=0.05) were used to make comparisons among treatments.

Results and Discussion

Germination. Germination of maize plants on sand indicated that germination was greatest in 1% terrasorb treatment followed by 0.5% terrasorb and the lowest count was in the untreated sand (Fig. 1). The differences in germination of

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maize in 1% aquasorb and 0.5% terrasorb treated sand were not significantly different from 1% terrrasorb. The polymers caused a significant increase in germination compared to 0.5% organic manure and untreated sand.

The maize seed germination tended to be lower on clay loam soil than the sand in most cases. The highest germination was in 1% aquasorb treatment and lowest stand was in untreated clay loam. The differences in germination amongst 1% organic manure, 0.5 and 1% aquasorb and terrasorb treatments were insignificant.

For soybean the highest germination was in 1% terrasorb-treated sand followed by 0.5% terrasorb and 1% aquasorb treatments in sand but the differences among the above treatments were not significant (Fig. 2). The germination in untreated sand and clay loam (46%) was significantly lower than all other treatments except 0.5% organic manure treatments both on sand and clay loam soils. Application of polymers enhanced germination of soybean on sand compared to the same treatments on clay loam as well as organic manure both on sand and clay loam. Polymers improved germination on clay loam which was higher than untreated clay loam and sand. Polymers had pronounced effect on germination of both crops on sand.

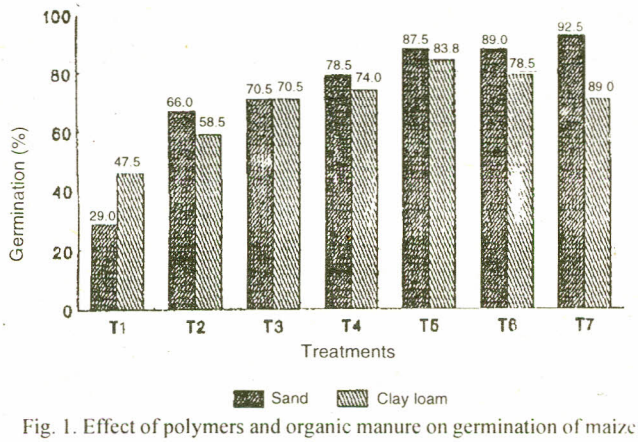

Fig. 1. Effect of polymers and organic manure on germination of maize (LSD: Sand = 32.5, Clay loam = 14.8).

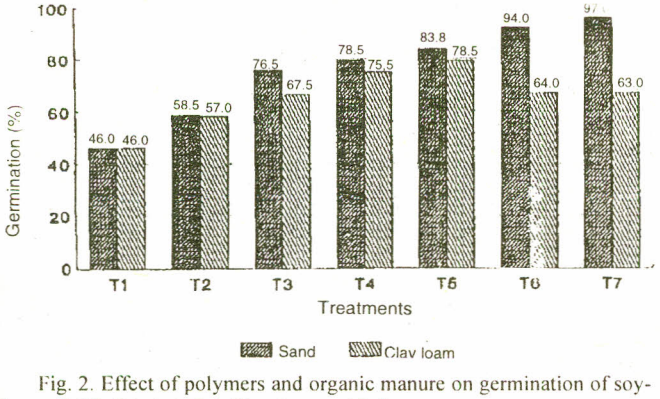

Fig. 2. Effect of polymers and organic manure on germination of soybean. (LSD: Sand = 13.4, Clay loam = 15.4).

Galeva [7] reported that polyacrylamide improved the physicochemical properties of soils. Owen [8] has shown relationship of seedling emergence with soil heat and water was associated with the application of polymers.

Shamuganathan and Oades [9] showed that polymers improved porosity of soils. De Boodt [10] sated that polymer application promoted the germination of sugar beets in France, Belgium and Germany. Wallace and Wallace [5] found that polymer increased emergance of seedlings in tomato, cotton and lettuce. Similarly in present study, the enhanced germination due to polymer application may be attributed to the improved physical soil conditions. Exchange of air, water holding capacity and moisture supply might have been improved which provided favourable environment for the germination of seed and emergence of seedlings.

Plant height. On clay loam soil, the height of maize plants recroded on May 8 was greatest with 1% aquasorb, followed by 0.5% aquasorb and 1% Terrasorb treatments (Fig. 3). The polymer treated soils had greater plant height than the organic manure and untreated clay loam soil.

On sand, 1% aquasorb showed greater height than 0.5% terrasorb, 0.5 and 1% organic manure and untreated sand

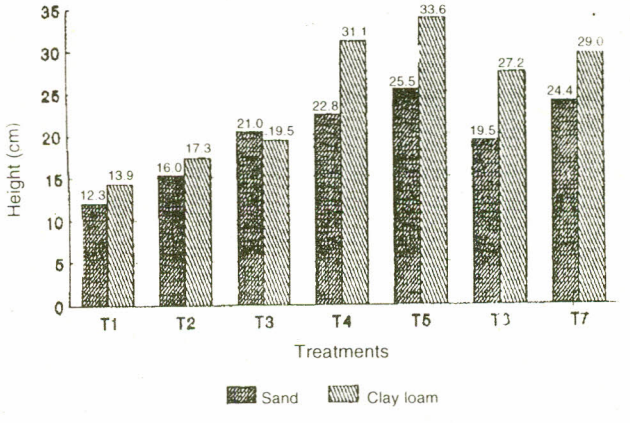

Fig. 3. Effect of polymers and organic manure on height of maize plants (LSD: Sand = 8.7, Clay loam = 6.7).

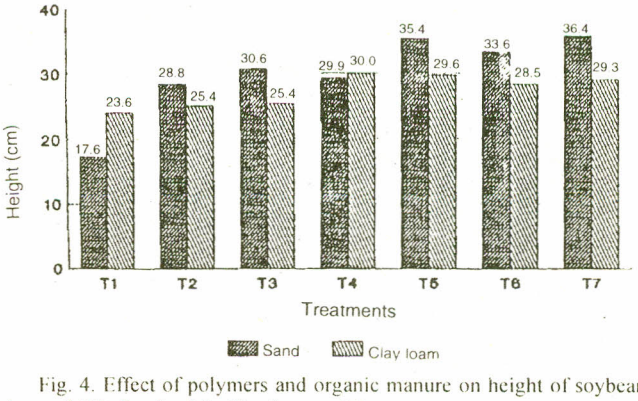

Fig. 4. Effect of polymers and organic manure on height of soybean plants. (LSD: Sand = 5.8, Clay loam = 4.6).

whereas differences in plant height among 0.5 and 1% aquasorb and 1% terrasorb treatments were insignificant.

The polymer treatments showed greater height of plants on clay loam than sand. The differences in plant heights on organic manure-treated and untreated sand and clay loam were not significant.

On sand, soybean plants in 1% terrasorb treated sand showed largest plant height, followed by 1% aquasorb and 0.5% terrasorb (Fig. 4). Lowest plant height was in untreated sand. The differences in the height of plants grwoing on both polymers and 1% organic manure were not significant and all these values were significantly higher than untreated sand.

On clay loam soil, soybean plants had the lowest height in the untreated soil and the greatst height was in 1% aquasorb treatment. Although different treatments including polymers and organic manure caused some variation in plant heights, these differences were not significant. The plants with polymer and organic manure were taller in sand than in clay loam in some treatments. The height was lowest in untreated sand followed by untreated clay loam whereas maximum height was found in 1% terrasorb-treated sand.

For both crops on both soils, polymer treatment enhanced the plant heights compared to the untreated soils and organic manure treatments as well. Garble [11] reported that increase in plant growth was mainly because of improved aeration by polymer application. Johnson [6] stated that the use of gel forming synthetic polymers as aids to water retention in sandy soils is an important development to assist plant growth in arid regions. Wallace *et al.* [12] found that polymer application increased the vegetative growth of plants over control.

Permanent wilting of plants. The data on survival of maize plant till they permanently wilted indicated that largest duration of plant survival was in 1% aquasorb-treated sand (14.7 days) and 0.5 and 1% aquasorb-treated clay loam (16.3 days) (Fig. 5). Maize seedlings survived for the shortest duration in the untreated sand (8 days) followed by 10 days with 0.5% organic manure-treated sand. Permanent wilting point (PWP) in the polymer-treated sand occurred at a much later stage compared to organic manure-treated and untreated sand. The differences in the duration of PWP amongst both levels of aquasorb and terrasorb were not significant but they showed significantly greater duration compared to organic manure and untreated sand.

Maize seedlings on clay loam soil showed almost the same trend but they survived for a longer period compared to that of sand. The plants growing in 0.5 and 1% aquasorb treated soils survived for the longest duration compared to all other treatments followed by 1 and 0.5% terrasorb and 1% organic manure treatments. Although untreated sand showed the shortest duration for arriving at PWP, it did not differ significantly with those of 0.5 and 1% organic manure and 0.5% terrasorb treatments.

For soybean, the plants survival for the longest duration was in 1% aquasorb-treated sand (30 days) whereas the shortest duration of 26 days in untreated sand (Fig. 6). It was also observed that polymer addition increased the duration of plant survival more than organic manure. The plants lasted longer in 0.5 and 1% aquasorb and terrasorb-treated sand in comparison to other treatments.

On clay loam soil, the plants survived for the longest duration in 1% aquasorb-treated clay loam (39 days) followed by 0.5% aquasorb (34 days), 1% terrasorb and 0.5% terrasorb application. The duration to reach PWP was shortest in the untreated and 0.5% organic manure treated clay loam. The differences amongst 1 and 0.5% organic manure and untreated clay loam soil were not significant.

Maize and soybean plants survived for a longer period in the polymer-treated soils compared with organic manure and untreated ones. The durations of survival were more on clay loam soil than sand.

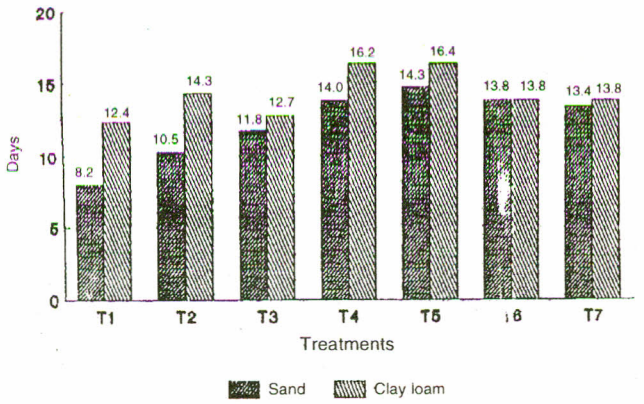

Fig. 5. Effect of polymers and organic manure on permanant wilting point of maize plants (days after germination). (LSD: Sand = 3.4, Clay loam = 2.2).

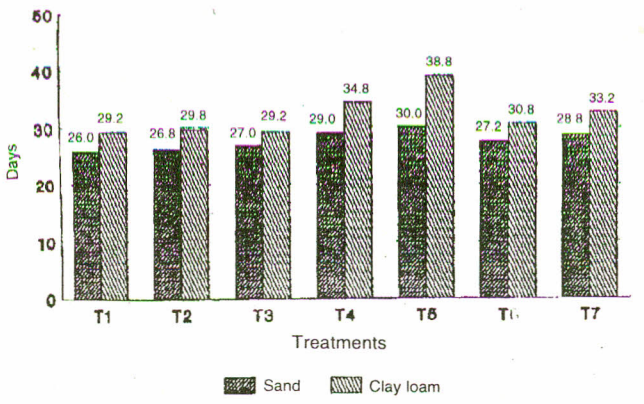

Fig. 6. Effect of polymers and organic manure on permanant wilting point of soybean plants (days after germination). (LSD: Sand = 2.0, Clay loam = 2.2).

Soil conditioners have been reported to be of potential importance in arid and semi arid regions where these materials can favourably modify soil water relationships especially retention and transmission of water [13]. Wallace and Nelson [12] found that polymers imporve physical conditions of soil and have favourable effect on plant grwoth. Rasp [14] reported that polymer application improved the water holding capacity in light textured soils and aeration in heavy soils. Hemyari *et al.* [2] and Al-Omran *et al.* [3] stated that gel conditioners proved to be effective in increasing water holding capacity and decreasing deep percolation on sandy soils. Galeva *et al.* [15] expressed that polyacrylamide improved the physicochemical properties of soil and reduced the requirements for irrigation. Makled *et al.* [16] revealed that polymer application enhanced the sorptive capacity of soil.

The polymers had a pronounced effect on increasing germination, plant height and survival of both maize and soybean on sand and clay loam soils. Thus they can be used as a security of crop production under stess conditions especially where soil moisture is a major constraint to crop production. Under irrigated conditions, the frequency of irrigations can be reduced by increasing the interval of irrigation. Further studies need to be carried out under field conditions and on some other crops such as vegetables, fruits and ornamental plants.

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