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RESPONSE OF POTATO *(SOLANUM TUBEROSUM)* TO SEEb AND FOLIAR APPLICATION OF IRON AND MANGANESE

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The present study was conducted to see the response of potato plants to the application of iron and manganese. Seven treatments were used in this study. In three treatments the potato seeds were dipped in 2% solutions of $FeS0_4$ and $MnS0_4$ and $FeS0_4$ + $MnS0_4$ respectively for one hour before sowing and in the other three. 500 ppm each of above solutions were sprayed on the leaves twice during the growth period keeping the first treatment as control. The parameters studied were tuber yield. mineral matter and carbohydrate accumulation and moisture contents. An inconsistent and variable response to seed dipping as well as foliar application of Fe and Mn was observed..,
Key words: foliar spray. iron, manganese. potato, seed dipping

INTRODUCIION

Potato *(Solanum tuberosum)* is a rich source of carbohydrates and is one of the most commonly consumed vegetables in the whole world as well in Pakistan. Many researcher have reported high requirements of potato for macronutrients such as N.P and K (Muhammad et al., 1989 and Salah-ud-Din et al., 1997) Micronutrients are as essential for plant growth and development as the macronutrients. These are, however, required in very small quantities. Previously, it was considered that most of the soils can supply these minute amounts easily. It is now feared that high yielding crop varieties are mining our soils of all the nutrients especially the micronutrients because their addition as fertilizer element is negligible. Iron and manganese are involved in metabolic processes and these are considered activators of important enzymes (Mengal and Kirkby, 1987). Iron is also a structural component of haemoglobin and cytochrome (Tisdale et al., 1985). Potato has been categorized as less sensitive to Fe deficiency (Rashid and Din. 1992), while moderately sensitive to Mn toxicity (Lucas and Knezek, 1972). The data available in Pakistan regarding the response of potato to micronutrients are very meager. This study was planned to study the response of potato to seed and foliar application of iron and manganese.

MATERIALS AND METHODS

The present experiment was conducted in the field. The plot size was 1.410x 6m. The preexperiment soil analysis was Eee = 2.1 dSm-'; pH = 8.2; N = 0.05 %: P = 5.4 ppm; K = 175 ppm; Fe = 20 ppm and Mn = 29' ppm. Recommended doses of NPK fertilizers were applied to all the plots. The treatments used were: T_1 -control (No Fe or Mn was applied); T_2 - 2% $FeS0_4$ solution used to dip; T~ - 2% $MnS0_4$ solution used to dip seeds for one hour: T_4 - 2% $FeS0_4$ + 2% $MnS0_4$ solution used to dip seeds for one hour: T_5 - 500 ppm $FeS0_4$ solution sprayed on plants twice; T_6 - 500 ppm $MnSO_4$ solution sprayed on plants twice; T_7- 500 ppm $FeS0_4$ + 500 ppm $MnS0_4$ solution sprayed on plants twice. In case of 2nd, 3rd and 4th treatments, solutions were applied before sowing, while with last three treatments, solutions were sprayed on leaves twice, first after thirty days of sowing and then after sixty days of sowing. The crop was harvested at maturity. The tuber yield data were recorded and mineral matter as well as moisture contents were detenuined. Tuber samples were collected and analyzed for carbohydrate content colorimetrically at 490 nm using the method of Jhonson et al. (1966).

RESULTS AND DISCUSSION

The tuber yield and other quality parameters gave an inconsistent response to the application of both iron and manganese. The response also differed non - significantly when two methods of application were compared. The maximum potato yield (31.41 t ha") was observed with the combined application of 2% $FeSO_4$ and 2%$MnS0_4$ solution for seed dipping before sowing (Table 1).It differed non- significantly in respect of yield response from all other treatments except the lowest (26.11 t ha-I), one where potato seeds were dipped in 2 % $FeS0_4$ solution only. There was also no statistical difference due to the use of two methods.

Similar to the fresh tuber yield, the maximumpercentage of mineral matter was obtained when seeds 'were dipped in 2 % $FeS0_4$ + 2 % $MnS0_4$ solution (Table 2). However, it differed significantly only from the results obtained with an application of 2% $FeS0_4$ solution to seeds and the foliar application of 500 ppm $FeS0_4$ + 500ppm $MnS0_4$. It may be noted that seed application and foliar application techniques yielded results that were contrary to each other when Fe and Mn were applied together, while in case of all the other treatments, these techniques led to similar results.

Potato tubers are rich source of carbohydrates. In the present study, both the seed dipping as well as foliar application of Fe and Mn failed to improve the carbohydrate contents (Table 3). The seed application of 2% $FeS0_4$ solution alone and even when used in combination with 2% $MnS0_4$ solution,' lowered the carbohydrate concentration significaatly in tubers. compared to the control. All the other treatments were statistically at par with the control. The moisture percentage increased in general with the application of Fe and Mn applied by either method. However , the effect was only' significant when 2% $FeS0_4$ solution was applied to the seeds either alone or in combination with 2% $MnS0_4$ solution (Table 4).

Both iron and manganese play an essential role in plant metabolic reactions. Iron is a transitional element capable of accepting and donating electrons, hence it is involved in oxidation - reduction reactions in plants and providing potential for many of the enzymatic transformations in the plants (Tisdale et at, 1985). Manganese is also involved in enzyme activation. Mengel and Kirkby (1987) has described its role in CO_2 assimilation and N metabolism. The improvement in certain parameters in this study may be due to their improved availability resulting from additional application of Fe and Mu, whereas decrease in certain other parameters may be attributed to their toxicity because their optimum and toxic limits are very close. However. the non-significant effect 'on most of the parameters shows the poor response of potato to additional Fe and Mn supply by either seed, dipping or foliar spray. Similar inconsistent results of micronutrient application including Fe and Mn have been reported earlier in Pakistan (Anonymous, 1989-90). Only a few studies have shown positive effects of micronutrients on certain crops on certain types of soil (Khattak and Sajida, 1994). Parsad and Gupta (1989) studied the response of soil and foliar application of $MnS0_4$ to radish and reported a non-significant yield increase with foliar application and a significant yield increase due to soil application. Improved growth of radish due to soil application of MnS04 has also been reported by Heeman and Campbell (1980). It might, therefore, be concluded that response of vegetables to the micronutrients is a site and crop specific phenomenon in contrast to the universal response to NPK. Further, the availability of most of the micronutrients is changed with change in oxidation - reduction stale of soil. Therefore, recommendations for use of micronutrient fertilizers require a consideration of soil moisture regime as well as specific nutritional requirements of a crop in addition to simple soil analysis.

Table 1. Effect of Fe and Mn on tuber yield of potato

Treatments	Tl	12	1'3	T4	T5	T6	17
Yield (t ha')	29.06 ab	26.11 b	27.15 ab	31.41 a	28.49 ab	28.10 ab	2822 ab

Table 2. Effect of Fe and Mn on mineral matter percentage of potato

Treatments	'Tl	12	1'3	T4	T5	T6	17
Mineral matter	1.29 abc	.. 1.25 be	1.37 abe	1.41 a	1.39 ab	1.36 abc	1.23 e

Table 3. Effect of Fe and Mn on carbohydrate content of potato

Treatments	Tl	12	1'3	T4	T5	T6	17
Carbohyd-rates (%)	15.93 a	14.13 bc	15.05 ab	13.63 c	14.66 abc	15.31 ab	15.23 ab

Table·4. Effect of Fe and Mn on moisture content of potato

Treatments	TlT	12	1'3	T4	T5	T6	17
Moisture (%)	80.2 c	81.6 ab	80.8 be	82.4 a	81.2 abc	80.9 abe	80.9 abc

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