EFFECT OF DIFFERENT MICRO AND MACRO-NUTRIENTS ON THE INCIDENCE OF POTATO WILT CV. DIAMANT

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Pot experiments were conducted to evaluate the effects of various micro- and macro-nutrients on the growth of potato wilt. Potassium and Ca alone and in combination reduced the wilt incidence. However, the wilting was reduced more in Diamant compared to Lal-e-Faisal. Plant height and number of tubers were also increased in both the cultivars, especially with the application of KCl and $FeSO_4$.

INTRODUCTION

Potato *(Solanum tuberosum* L.) is one of the most important vegetable crops grown in Pakistan. The total area (spring, autumn and hill crops) is 62 x 10^3 ha with a total production of 618 x 10^3 tonnes of tubers (Anonymous, 1986). The present yield/ha is low as compared to that of the advanced countries. The main reason being the disease problem. Out of various diseases, "wilt" is assuming its importance in Pakistan due to the introduction of susceptible cultivars. Besides, other factors micro-nutrients availability in the soil is a strategic weak point for the control of *Fusarium,* since the fungus is more vulnerable to micronutrients than the host plant. In soils rich in K, Ca, Zn, and Fe, the *Fusarium* propagules are less likely to establish significant inoculum level in the soil. Among the other controls, the use of micronutrients as soil amendments is one of the most effective and the cheapest methods of plant disease control. A promising approach to the control of this soil-borne disease includes an evaluation of the nutritional requirement of *Fusarium oxysporum* and a study of the disease relations to various levels, sources and combinations of nutrients (Steinberg, 1959).

In the past, *Fusarium* wilt was favoured by potassium deficiency, low pH and high nitrogen contents of the soil (Garret, 1956), and the application of K and S resulted in reduction of its incidence (Kommedhal *et al.,* 1970). Potassium as 125 kg produced the maximum yield of potato and reduction of *Fusarium oxysporum* f. *tuberosi* (Kumar *et al.,* 1983) and hydrated lime and ground lime added in soil reduced the incidence of *Fusarium oxysporum f. lycoperisici* (Jones and Woltz, 1970). In experiments, elsewhere, zinc was found to be highly effective in controlling the *Fusarium* wilt (Yogeswari, 1948). Present study thus was considered important to find out suitable control of this disease through the use of different micro- and macro-nutrients as soil additives.

MATERIALS AND METHODS

Pot experiments were conducted to demonstrate the effect of K, Ca, Zn and Fe on the incidence of potato wilt, plant growth and tuber development. Soil was sterilized with 2% formalin and kept covered with wet

gunny bags for 24 hours and left open for eight days till it was free from formalin fumes. The pots were amended with K, Ca, Zn and Fe @ 125, 125, 0.2 and 2.0 ppm in the form of KCl, $CaCl_2$, $ZnSO_4$ and $FeSO_4$, respectively. To add the inoculum in the soil, 3/4 of the soil from pot was removed and blocks of inoculum (5 mm^2) grown on Waksman's medium were placed in the soil and this inoculum was covered with approximately 2 cm thick layer of soil. Similarly, three layers of inoculum and soil alternating with each other were placed in these pots. The experiment was laid out in CRD with three repeats of each treatment for both the varieties i.e., Lal-e-Faisal and Diamant. The treatments included KCl, $CaCl_2$, $ZnSO_4$, $FeSO_4$, KCl + $CaCl_2$, KCl + $ZnSO_4$, KCl + $FeSO_4$, $CaCl_2$ + $ZnSO_4$, $CaCl_2$ + $FeSO_4$, $ZnSO_4$ + $FeSO_4$ and the control.

The soil was analysed (Richards, 1954), i.e. 10 g was extracted with 20 ml extracting solution (3.935 g DTPA + 2.94 g $CaCl_2$ + 26.6 ml TEA per 2 L, the volume was made with distilled water). The filtrate was analysed for Zn and Fe with the atomic absorption spectrophotometer. Plant samples (1 g powder) were digested by di-acid mixture of 20 ml concentrated nitric acid and 10 ml perchloric acid per sample (Richards, 1954).

The pathogenicity studies were conducted in pots under controlled conditions. Pots and potato seeds were disinfected with 0.1% mercuric chloride solution and filled with sterilized soil. Four potato tubers were sown in each pot and inoculum of *Fusarium oxysporum* and *Fusarium solani* added uniformly in pots. These pots were then kept in the green house at 28 ± 2° C. Isolations were made from the wilted plants and the causal fungus confirmed.

Table 1. Effect of micro- and macro-nutrients on potato cv. Diamant in pots.

Treatments (individual)	With respect to		
	Mortality (%)	Height (cm)	Tubers (Nos.)
Control	83.3 a	27.7 c	5.0 d
Zinc sulphate	50.0 b	38.3 ab	10.3 bc
Ferrous sulphate	41.7 c	40.7 ab	8.0 c
Calcium chloride	33.3 d	36.0 b	11.0 ab
Potassium chloride	25.0 c	43.7 a	13.0 a
Treatments (in combination)			
Control	83.3 a	28.3 b	6.0 b
$FeSO_4$ + $ZnSO_4$	41.7 b	45.0 a	9.6 ab
$CaCl_2$ + $ZnSO_4$	33.3 bc	41.0 a	12.0 a
KCl + $ZnSO_4$	33.3 bc	42.7 a	12.7 a
$CaCl_2$ + $FeSO_4$	25.0 bc	43.7 a	11.3 a
KCl + $CaCl_2$	16.7 c	46.7 a	14.3 a
KCl + $FeSO_4$	16.7 c	45.7 a	11.0 a

RESULTS AND DISCUSSION

Maximum number of plants were wilted in control whereas the mortality was least in KCl treatment (Table 1). Other treatments such as $ZnSO_4$, $FeSO_4$ and $CaCl_2$ also reduced the wilting. The plant analysis for various nutrients showed higher values compared to the control. When the nutrients were applied in combination, the per cent mortality was the lowest in KCl + $CaCl_2$, other combinations did reduce the mortality compared to control in both the potato varieties. Maximum height of plants was observed when nutrients were applied as KCl and KCl + $CaCl_2$ in both the varieties, other treatments also increased the height of plants and number of tubers compared to the control.

Both the varieties seem to behave likely for various treatments, but Diamant cultivar proved relatively tolerant than Lal-e-Faisal against wilt incidence. Studies carried out by Standaert and Myttenaere (1973), Garret (1956), and Edingtun and Walker (1958) supported these results.

Addition of different micro- and macro-nutrients to the soil increased the development of potato tubers especially with K and Ca alone and in combination. These results are in confirmity with the results obtained by Kumar *et al.* (1983). According to these workers, application of 125 kg of K fertilizer produced the highest potato yield and reduced the incidence of *Fusarium oxysporum* f. *tuberosi*.

Micro- and macro-nutrients alone and in combination (Table 1) showed that all the nutrients increased the height of plants compared to that of the control plants, especially K and Fe which gave maximum height (Table 1).

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