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NUTRITION MANAGEMENT IN CITRUS: EFFECT OF MULTINUTRIENTS FOLIAR FEEDING ON THE YIELD OF KINNOW AT DIFFERENT LOCATIONS

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Abstract

Maintaining health of citrus plants by nutrition management demands to deal citrus as a tree plant that has growth in shifts. There is a need to chalk out nutrition programme by keeping in mind growth as well as phonological cycles of the plant because every shift of growth in association with phonological and growth cycles needs special attention to decide fertilization programme. There is a need to develop well established production technology to increase the production of this crop substantially by using non-conventional approaches alone or in combination with conventional approaches. The use of multi-nutrient plant growth regulator formulation amended with appetizer is a new and innovative approach to develop a cost effective foliar spray "Micro Power" for improving citrus yield. Results from two demonstration trials revealed that NPK fertilizers (calculated on the basis of age and foliage on fruit trees rather than on the basis of area) application on drip line in combination with foliar spray was helpful to improve production of quality citrus (kinnow) fruits up to 63%. Moreover, this strategic management of nutrition was also helpful to identify appropriate time and growth stage for the application of fertilizer mix.

Introduction

Plant nutrient management can influence flowering, fruit set, fruit size and the amount of vegetative growth and other plant characteristics. By carefully choosing the components of fertilizer programme, the grower can nudge a crop toward earlier, heavier fruit set (Ibrahim *et al.*, 2004; Abd-Allah, 2006; Alva *et al.*, 2006). Foliar feeding has been used as a means of supplying supplemental doses of minor and major nutrients, plant hormones, stimulants and other beneficial substances. Observed effects of foliar fertilization have included yield increases, resistance to disease and insect pests, improved drought tolerance and enhanced fruit quality (Havlin *et al*., 2005; Omaima Metwally, 2007; Tariq *et al*., 2007).

Application of some nutrients (not all) through foliage can be from 10 to 20 times as efficient as soil application. However, this efficiency is not always achieved in actual practice due to weather extremes, application of the wrong spray mix, or of the right mix at wrong time (Perveen & Rehman, 2000; Yaseen *et al*., 2004; Alva *et al*., 2006; Zaman & Schumann, 2006). Foliar fertilizations are often timed to coincide with specific vegetative or fruiting stages of growth and the fertilizer formula is adjusted accordingly. Therefore, judging what foliar materials to apply and at what plant stage to spray with soil applied organic and inorganic fertilizers are important principles to make best uses of this technique. A properly formulated foliar spray particularly amended with appetizers/bioactive materials/bio-stimulants and surfactants increases uptake of nutrients from the soil (Yaseen *et al*., 2004) because foliar fertilization causes the plant to pump out more sugars and other exudates from its roots into the rhizosphere (Marschner, 2003).

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In Pakistan where the nutrient particularly micro-nutrient deficiencies are common due to low soil organic matter, alkaline soil pH and calcareous nature of soil (Rashid *et al*., 1997; Anon., 1998; Marschner, 2003; Zekri & Obreza, 2003; Zaman & Schumann, 2006), there is ample scope to develop a cost effective technology suitable for wide varieties of citrus crops under diverse climatic conditions. It is an admitted fact that this break through in fertilizer field will help our agriculture to overcome the low yield problem due to which our farming community and economy have been suffering badly for the last many years (Yaseen *et al*., 2004).

Citrus is grown on largest area among fruit crops in Pakistan but its quality and yield is far behind from the well managed farms and other citrus growing countries of the world. Average yield of citrus fruit per hectare is 9.2 tons that reflects poor exploitation of production potentials. Citrus is grown in all four provinces of Pakistan but Punjab produces over 95% of the crop. Punjab's share is the biggest due its soil and climate. Sargodha, Sahiwal and Toba Tek Singh are major citrus producing districts in the Punjab. Though, the demand of Pakistan fruits is enormous but our exporting potential is merely 8% due to a big chunk going waste on account of poor soil, crop and fertilizer management practices, poor quality (fruit with nutrient deficiency & disease symptoms) and poor management during harvesting, transportation, packaging and storage (Catara, 1987; Khattak, 1991; Zaman & Schumann, 2006; Tariq *et al*., 2007).

There is need to increase the production of exportable fruit quality substantially by using non-conventional approaches alone or in combination with conventional approaches. The use of multi-nutrient plant growth regulators formulation amended with appetizer could be a new and innovative approach to develop a cost effective foliar spray for improving crop yields. Integrated use of nutrients in association with different methods of application can render good production of crop year after year. This demonstration study was undertaken to manage nutrition of kinnow to get potential fruit yield on a larger scale on the farmer's field.

Materials and Methods

Demonstration field trials were conducted on Kinnow grown on 100 acres at progressive farmer's fields near Mian Chunno, Kabirwala and Khanewal. The plants were 6-7, 10-11 and 4-5 years of age at Mian Chunno, Kabirwala and Khanewal, respectively. The citrus orchard was previously regularly intercropped with wheat-cotton or wheat-maize fodder crops. Plants showed deficiency symptoms of nutrients particularly micronutrients as well as diseases and insect attack. Whole citrus orchard was heavily irrigated therefore there was a lot of water shoots on almost all the trees. The soils on all sites were non-saline, medium in texture, calcareous, alkaline and low in organic matter.

Keeping in view whole physical condition of plant, soil and climate of the area and considering citrus plants as tree, two types of demonstration trials were planned.

Trial 1

Treatment plan:

Control plant = Farmer's fertilization programme*

Treated plant = Multinutrient foliar spray (Micro Power) **

Trial 2

Treatment plan:

Control plant = Farmer's fertilization programme*

Treated plant = Soil application of NPK fertilizers*** + Micro Power

*Farmer's fertilizer program includes application of only nitrogen as urea and phosphorus as DAP fertilizers according to agronomic crops intercropped not according to the requirement of citrus plants. A little amount of potassium fertilizer was applied once after 2-3 years

** Micro Power contains a blend of macro and micro nutrients i.e. N=1%, K_2O=2%, Zn=2.5%, Fe=1%, B=0.5%, Mn=1% & Cu=0.2% amended with appetizer to improve nutrient use efficiency through foliage.

Two foliar spray @ 500 mL 100 L^{-1} of water were applied 15 days after flushing and 15 days after fruit formation.

*** N, P and K @ 200-150-250 g $tree^{-1}$ were applied three times before vegetative flush (1^{st} dose at last week of January, 2^{nd} at mid of April and 3^{rd} at end of July). Nitrogen as urea, phosphorus as SSP and potassium as SOP fertilizer were applied. Similarly foliar spray of Micro Power was applied @ 500 mL 100 L^{-1} of water 15 days after appearance of new vegetative flush, 15 days after fruit formation and 15 days after the appearance of vegetative flush in August.

At maturity five trees were randomly selected at each site and tagged for collection of data in 2005, 2006 and 2007. Fruits were harvested, wiped and weighed. Average of five trees were taken to record the weight of fruits per tree.

Results and Discussion

Traditionally farmers apply fertilizers according to requirement of intercrop or according to the time of application of intercrop rather than according to time of nutrient requirements of citrus tree. Very few farmers apply fertilizers directly to citrus tree by spreading uniformly under the tree canopy but not on the drip line. Their fertilization program include mainly nitrogen and phosphorus but little or no potassium. It is well known that order of nutrient requirement for citrus is potassium > nitrogen > phosphorus among macronutrients while Zn > Fe > B > Cu > Mn from among the micronutrients.

In these trials fertilization program was designed on the request of the farmer. The appearance and health of citrus plants clearly provided information about the effect of intercropping on plant health as well as time, method and amount of fertilizers application. Because citrus is a tree and, it has growth in cycles, therefore until or unless, fertilizer application program is properly designed according to growth cycle, it not possible to improve the plant health and fruit production (Yaseen *et al*., 2004; Alva *et al*., 2006; Zaman & Schumann, 2006).

Two demonstration trials were conducted on progressive farmer's field at three sites i.e. Mian Chunno, Kabirwala & Khanewal during 2005-2007. Plants were belonging to almost similar age group i.e., 6-7 years at Mian Chunno, 10-11 years at Kabirwala and 4-5 years at Khanewal sites. Data in Table 1 and Figs. 1-3 show the effects of foliar application of multinutrient "Micro Power" (Treated plant) in comparison with farmer's treatment (Control plant) on fruit yield of Kinnow at three sites during 2005 - 2007. Foliar application markedly increased the fruit yield compared to control and the extent of increase varied from 35 to 40 % at Mian Chunno, 22 to 39 % at Kabirwala and 24% at Khanewal over control during 2005 - 2007. Data show that application of micronutrients in right amount and at right time increased the fruit yield.

Table 1. Effect of foliar spray on fruit yield of Kinnow (kg) (average data of five trees) at different tress different site.

Treatment	Year	Sites					
		Mian Chunno		Kabirwala		Khanewal	
		Fruit yield (kg/tree)	% Increase over control	Fruit yield (kg/tree)	% Increase over control	Fruit yield (kg/tree)	% Increase over control
	2005	69	-	86	-	-	-
Control	2006	80	-	107	-	88	-
	2007	74	-	90	-	100	-
	2005	93	34.8	120	39.5	-	-
Treated	2006	115	43.7	142	35.5	109	23.9
	2007	104	40.5	110	22.2	124	24.0

Table 2. Effect of foliar and soil application of nutrients according to growth cycle on fruit yield of kinnow.

Treatment	Year	Sites					
		Mian Chunno		Kabirwala		Khanewal	
		Fruit yield (kg/tree)	% Increase over control	Fruit yield (kg/tree)	% Increase over control	Fruit yield (kg/tree)	% Increase over control
	2005	69	-	86	-	-	-
Control	2006	80	-	107	-	88	-
	2007	74	-	90	-	100	-
	2005	108	56.5	136	56.1	-	-
Treated	2006	130	62.5	158	47.7	128	45.4
	2007	121	63.5	127	41.1	147	47.0

In the second trial where NPK fertilizers (200-150-250 g tree^{-1}) were applied at three times i.e. before new flush at last week of January, mid of April and end of July with foliar spray of multinutrients 15 days after the appearance of new flush in February, 15 days after fruit formation and 15 days after vegetative flush in August. Bars in Figs. 4-6 and data in Table 2 elucidate the effect of management of soil as well as foliar applied nutrients on fruit yield of kinnow compared to control at all the three sites during 2005 - 2007. Results showed that increase in fruit yield of Kinnow over control ranged from 50 to 63%, 35 to 41% and 35 to 40% at Mian Chunno, Kabirwala and Khanewal, respectively.

Overall results suggest definite role of micronutrients in plant health and fruit production. These results also provide information that citrus plant need application of nutrients at critical growth stages when plant really has a demand of nutrition. The information obtained from these trials is helpful to design similar nutrition program according to growth and phonological cycles for other citrus areas. Moreover, results also pointed out that managed nutrition program is a key to economise the use of inputs with minimum pollution hazards for improving quality production of kinnow on calcareous, alkaline and low organic matter soil.

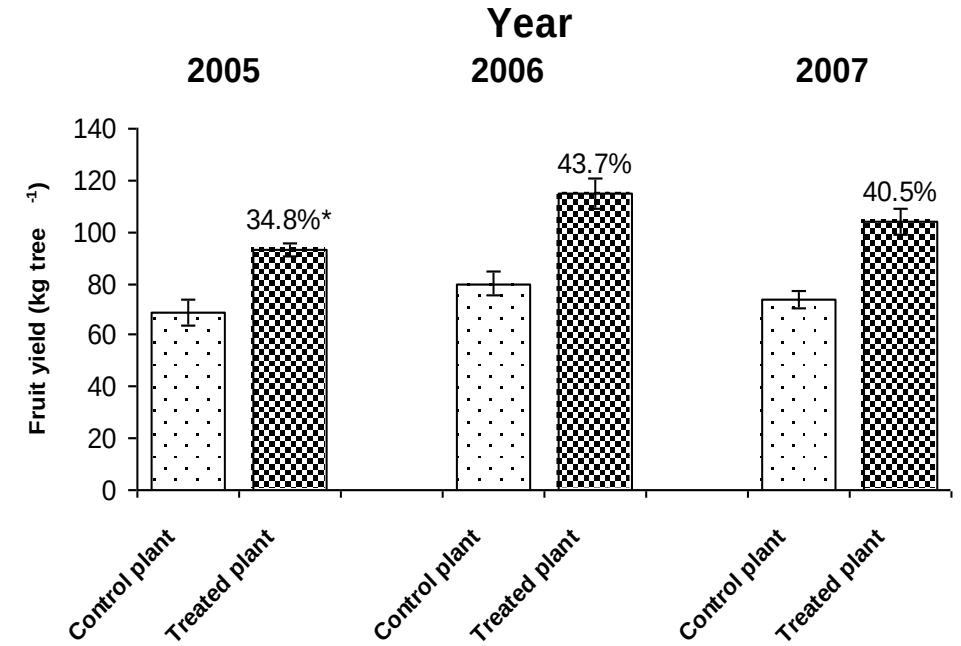

Fig. 1. Effect of foliar application of multinutrient spray on fruit production of kinnow at Mian Chunno.

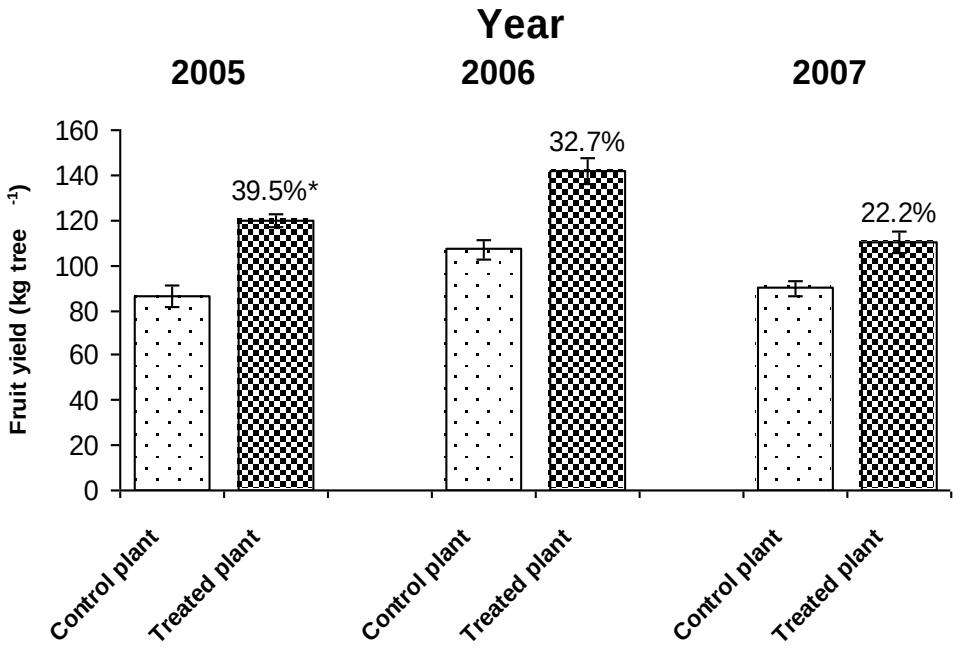

Fig. 2. Effect of foliar application of multinutrient spray on fruit production of kinnow at Kabirwala.

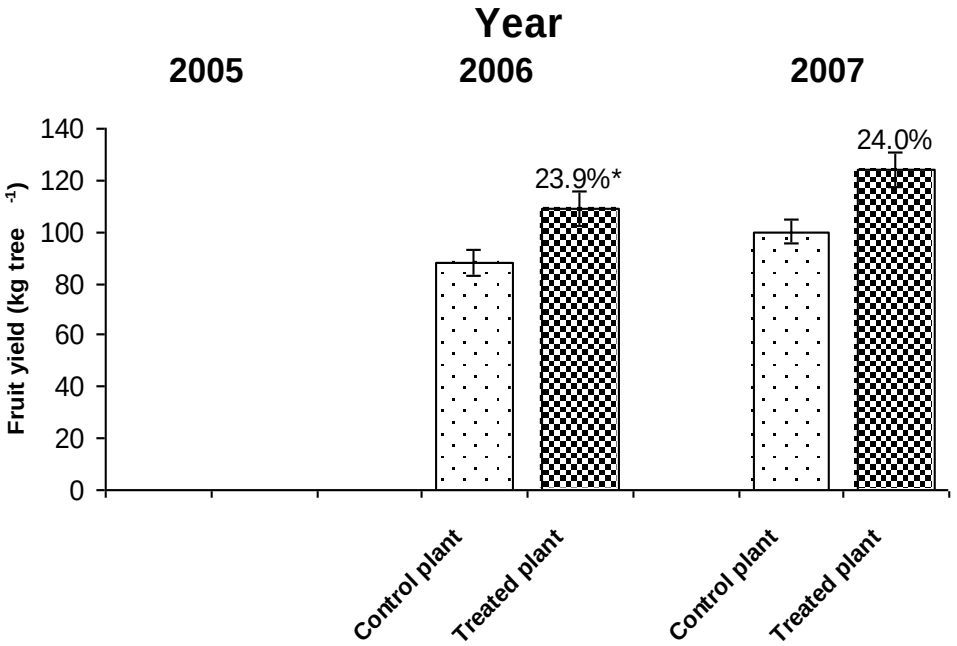

Fig. 3. Effect of foliar application of multinutrient spray on fruit production of kinnow at Khanewal.

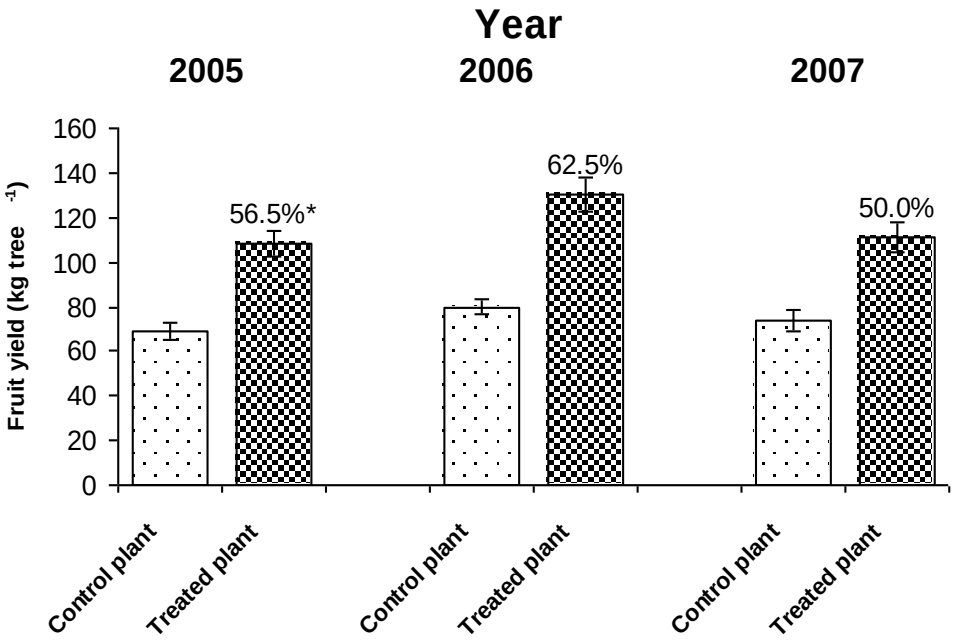

Fig. 4. Effect of soil and foliar application of nutrients according to growth cycle on fruit production of kinnow at Mian Chunno.

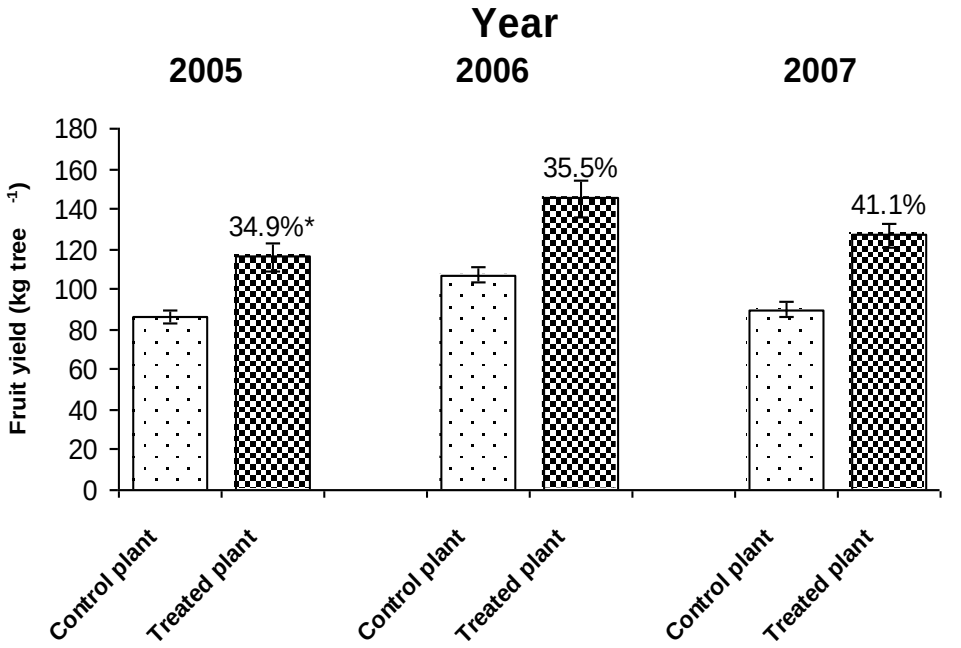

Fig. 5. Effect of soil and foliar application of nutrients according to growth cycle on fruit production of kinnow at Kabirwala.

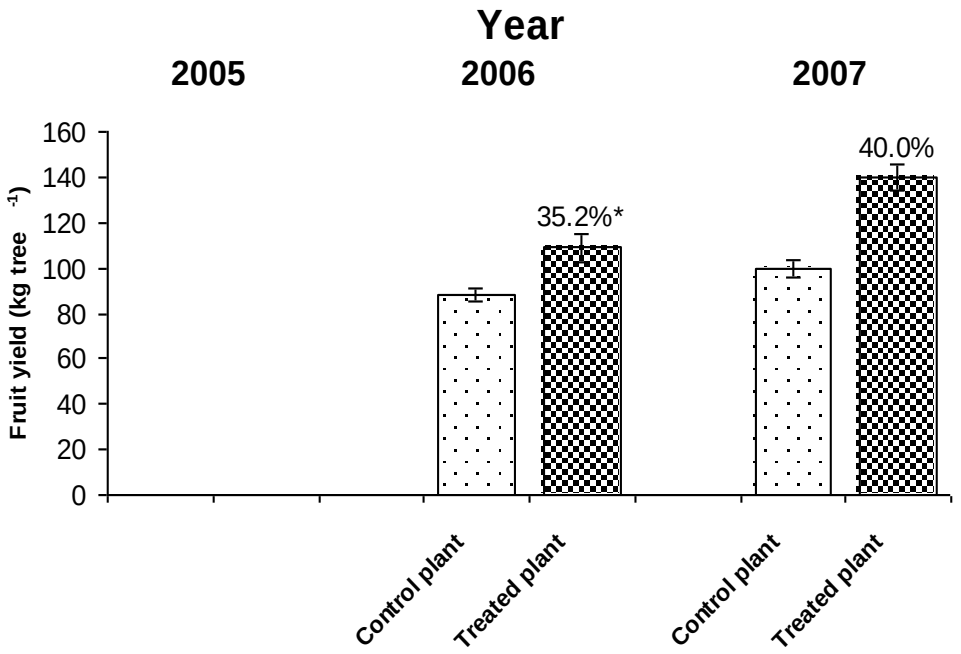

Fig. 6. Effect of soil and foliar application of nutrients according to growth cycle on fruit production of kinnow at Khanewal.

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