University of Jordan

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RESPONSE OF MUSKMELON TO APPLICATION RATES OF PHOSPHATE ROCK AND TRIPLE SUPERPHOSPHATE FERTILIZERS IN JORDAN VALLEY

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However, phosphorus rates application significantly increased total soluble solids of muskmelon fruit.

Application of phosphorus fertilizers at different rates tended to increase muskmelon leaf-P% at two locations.

There was a steadily decreasing trend in leaf-P% with progression of growing season at the two locations.

The concentration of Cu, Fe, Zn and Mn in muskmelon leaves were decreased by a relatively high rates of phosphorus fertilizers application.

However, triple superphospahte application tended to decrease the concentration of Zn, Cu, and Mn in muskmelon leaves .

1. INTRODUCTION

Muskmelon (Cucumis melo L.) is one of the important summer vegetable crops in Jordan especially in Jordan Valley. The area planted to muskmelon varies from year to another . The total area planted with muskmelon in 1987 was about 2810 hectars which equaled to 8.32% of the total area planted with vegetable crops. In 1989, the total area planted with muskmelon increased to 5330 hectars which equaled to 14.26% of total area planted with vegetable crops . (Agricultural Statistics Indicators, Ministry of Agriculture , 1992) .

Application of phosphours fertilizers to vegetable crops is an important practice. Phosphorus has a vital role in plant physiology as it helps in carbohydrate breakdown for energy release, cell division, transfer of inherited characteristics, stimulation of early root growth and development , hastening maturity of plant , fruiting and seed production, and energy transformation. (Johnes, 1982) .

Most of the vegetable growers apply superphosphate (more soluble phosphorus fertilizers) to their fileds. Phosphorus supplied by this type of phosphorus fertilizers can be fixed in the soil by several ways. In respect to soils of Jordan, calcium phosphate fixation may result in lowering the availability of added phosphorus.

The precipitation of phosphorus occur in reaction with calcium compounds . (Asian Vegetable Research and Develpment center, 1992) .

$$Ca(H_2PO_4)_2 + CaCO_3 \rightarrow Ca_3(PO_4)_2 + 2CO_2 + 2H_2O$$

(Soluble) (insoluble)

Thus, large portion of added phosphate will become temporary unavailable to the plants .

Rock phosphate as a low soluble P-fertilizer could be a possible source of phosphorus for low phosphorus requiring plants . In addition to that , the cost per unit phosphours from a rock phosphate source is lower than from triple superphosphate.

Numerous studies have been conducted to study the agronomic effectiveness of rock phosphate as a source of phosphorus for plants. The general consensus is that the effectiveness of rock phosphate can vary from being almost equal to superphosphate to no responed at all, depending on rock phosphate sources, crop species, and soil factors.

Given that Jordan is one of the main producing countries of raw rock phosphate , the cost of this material would be low as compared to manufactured fertilizers like triple superphosphate.

It is important to study the efficiency of this raw material relative to the more soluble fertilizers. Such a study might prove helpful especially in production of some vegetable crops that are low in phosphorus requirement such as muskmelon.

The objectives of this study , were to study the effects of :-

1. Phosphorus source and rates on $NaHCO_3$ - extractable soil phosphorus .
2. Phosphorus source and rates on muskmelon yield and qualuity .
3. Phosphorus sources and rates on mineral composition of muskmelon leaves .

2. LITERATURE REVIEW

2.1. Role of phosphorus in plants :-

Phosphorus, along with nitrogen and potassium, is a major nutrient for plant growth . This classification is based primarily on the amount of the element that is found in plants and not intended to reflect the relative importance the nutrients . (Follett et al ., 1981; Johnes, 1982) .

Most of literature (AVRDC, 1992; Johnes, 1982; Follett et al., 1981) mentioned that phosphorus has a vital role in plant physiology as :

1. A constituent of AMP, ADP and ATP. Phosphorus plays also an important role in plants energy storage and transfer . Once the energy has been stored in ADP or ATP , it can be utilized to drive other energy - requiring reactions such as the synthesis of sucrose, starch, and proteins. The process of donating energy to another molecule is also known as phosphorylation .

2. Electron transport :

Many processes in the plant involve oxidation reduction reactions . Compounds known as pyridine nucleotides act as electron or hydrogen transporters or carriers in these reactions.

Phosphorus is an essential component of coenzymes like nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) .

3. Nutrient transport :

Active nutrient absorption requires energy expenditure . The sources of that energy is respiration . Energy for the active transport system across the plasma membrane is moved from the point of the energy generation to the point of expenditure in a chemical form of ATP which provides energy to the transport mechanism by phosphorylation of a carrier molecule on the inside of the membrane. The carriers travel across the membrane in a cyclic process and attache to the ion to be brought in through energy provided by ATP. Conditions that limit the production of energy in respiration such as low temperature and nutrient deficienceies also limit nutrient absorption (Follett et al., 1981; Johnes, 1982) .

4. Reproduction :

Phosphours is an integral part of the plant reproductive system as a component of the genetic memory system ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) . Specifically, the role of phosphours in the structure of those two compounds directly or indirectly controls every biochemical reaction occurring in plants .

Phosphours storage occurs in seeds to prepare them for germination and early growth prior to extensive root development .

Phosphours also have a role in cell division , fruiting and seed production (Follett et al., 1981; Johnes, 1982; AVRDC, 1992) .

2.2. Phosphate rock and calcareous soils :-

Numerous experiments were conducted to compare different forms of phosphorus fertilizers under a wide range of climatic and soil conditions . The results of these experiments were different from one experiment to another due to soil and fertilizer factors. The effect of calcium fixation of phosphours is a phenomenon in soils containing appreciable quantites of calcium carbonate (Follett et al, 1981, and AVRDC, 1992) . Johnson and Olsen (1972), postulated that in the micro - environment surrounding a particle of phosphate rock in contact with a plant root, the uptake of phosphate from the fluorapatite may take place.

$$Ca_{10}(PO_4)_6F_2 \rightarrow 10\,Ca^{++} + 6\,PO_4^{3-} + 2\,F^-$$

These suggested that the process by which plants take up more calcium than their apparent metabolic needs appeared to be the means by which phosphate could be released from such sparingly soluble sources.

The hypothesis would also explain why rock phosphate is more effective on acid soils than on alkali soils which contain high concentration of exchangeable calcium (Follett et al., 1981; Johnson and Olsen, 1972; Nichols et al., 1960; Simard et al. , 1988 a,b; Lajtha and Bloomer, 1988 ; and Archer, 1978) In an experiment conducted to compare different forms of phosphatic fertilizers as sources of phosphorus for grassland in England , Archer , (1978) found that at location where the soil pH was initially above 6.0 or where lime had been applied shortly before the phosphate treatments, the rock phosphates did not become as effective as the phosphours fertilizers in the form of superphosphate , granular basic slage, and powdered basic slage during the periods over which yields were recorded. Chien (1978) suggested that phosphours concentration in the soil solution would increase only when the calcium concentration decrease as the phosphate rock is applied to the soil .

Kittams and Attoe (1965) found that pH of calcareous soils considered unfavorable for conversion of the phosphours in rock phosphate to more soluble forms .

Rock phosphate was more effective in promoting alfalfa growth than superphosphate when calcium carbonate was not added in acidic soil . (Nichols et al., 1960) . Nichols et al , (1960) and Simard et al., (1988 a ,b) also found a general decrease in phosphours uptake from rock phosphate and a corresponding reduction in $NaHCO_3$ - extractable phosphorus as the rate of $CaCO_3$ addition increased .

Lajtha and Bloomer (1988) , found a strong correlation between phosphours adsorption onto soil complex with increasing soil $CaCO_3$.

Matocha et al. (1970), found in a soil with pH of 7.8 and small amounts of free calcium carbonate, the application of phosphours during an earlies 10 - year period showed about the same yield responses as did phosphorus application during the year of cropping .

The pH of calcareous soils was considered unfavorable for conversion of phosphorus in the rock phosphate to more soluble forms (Kittams and Attoe, 1965; Ashby et al., 1966) . Kittams and Attoe, (1965) showed that application of rock phosphate-sulfur fusions to soil (pH 6.6) increased total yields of ryegrass up to 4.8, 2.5, and 4.9 times that of the non phosphated soil , rock phosphate alone and superphosphate , respectively .

The fusions gave up to 49% recovery of applied phosphorus compared to 21% and 62% for rock phosphate alone and superphosphate , respectively , but the recoveries of phosphorus from rock phosphate sulfur fusions were very low in soils of high pH (7.5 - 7.9) .

Ashby et al., (1966) found that both ryegrass yield and phosphorus uptake increased with each increase in level of acidulation of rock phosphate. In adition , coating of the rock phosohate granules with elemental sulfur gave no significant increase in yield , but increased phosphorus recovery significantly in several cases , particularly for the highest rate of sulfur on a soil with pH 7 .

2.3. Plant response to phosphate fertilizers :-

2.3.1. Yield :-

Different sources and rates of phosphorus fertilizers resulted in different yield responses in several cereal and vegetable crops depending on soil and plant factors. According to Locascio et al., (1967), an increase in the rate of applied phosphorus to 116 kg P / ha increased fruit yield of watermelon grown in acidic soil. Further increase in phosphorus rate resulted in small variation in watermelon yield.

The results of Bradley and Fleming (1958), indicated that the application of mono superphosphate at the rate of 33.6 and 67.2 kg P_2O_5 /ha on acidic soil (pH 6.0) low in available phosphorus increased watermelon yield from 10.98 ton/ha to 17.60 and from 16.9 to 24.44 tons/ha for years of 1956 and 1957, respectively. Also, the results of Srinivas and Parbhakar (1984) indicated that application of phosphorus fertilizers at a rate of 60 kg P_2O_5/ha significanlty increased the yield of muskmelon grown in acidic soil with low available phosphorus compared to phosphorus applied at rate of 30 kg P_2O_5/ha. On the other hand, Hassan et al., (1984) found that the application of phosphorus fertilizer at different rates had no significant effects on the yield of oriental pickling melon (Cucumis melo var. conomon) grown in acidic soil (pH 5.6) having 86.66 kg/ha of the available phosphorus.

In a study carried out in two sites, Blatt and McRae (1986) found that at high phosphorus soil site (500 kg p/ha), progressively higher rates of banded phosphorus with the same rate of nitrogen and potassium caused a progressive decline in tomato yield , but at the low phosphorus soil site (91 - 101 kg p /ha) , higher rates of banded phosphorus caused a significant increase in tomato yield . Suwwan et al., (1987) also found that the application of both nitrogen (0, 80, 160 and 320 kgN/ha) and phosphorus (0,100 and 250 kg P_2O_5/ha) had no significant effect on plastic house tomato yield grown in alkaline soil containing 10.5 ppm of available phosphorus in 1980 season. However, the application of 250 kg of P_2O_5 in the form of mono super-phosphate tneded to give higher marketable yield in 1981 season .

Superphosphate application was found to increase tomato yield linearly with phosphorus application (0.02 - 0.54 kg P/m^2) when added at preplanting to soil of pH 7.1 - 7.4 (Gibson and Pill, 1983) .

In an experiment to study the response of 9 vegetable crops to phosphorus in acidic soils with a relatively high capacity to immobilize phosphorus, the phosphorus concentrations in soil solution were ranged from 0.003 ppm doubling at each level to 1.6 ppm (Nishimato et al., 1977) . These authors found that most crop produced maximum yields at 0.20 to o.30 ppm phosphorus in soil solution , although transplanted head cabbage and sweet potato produced mximum yield at 0.04 and 0.1 ppm, respectively.

The yield curves for sweet potato, chinese cabbage, leaf lettuce and tomato indicated a trend towards depressed yield at the highest phosphorus concentration in soil solution .

Yield of alfalfa grown in acidic soil (pH 5.1 - 5.9 and 15.86-28.0 kg/ha of available P) always increase with application of superphosphate and some times with the application of rock phosphate in some soil types depending on soil pH (Thurlow and Smith , 1960). Nichols et al., (1960) found that there were no significant differences between yield of alfalfa plots treated with rock phosphate and superphosphate , but superphosphate was significantly better than rock phosphate when lime was applied .

There was an excellent response of corn to phosphours applied in the forms of concentrated superphosphate or 20% partially acidulated rock phosphate in low available phosphorus (5-12 kg/ha) acid soil (pH 5.3 - 5.7) . Yields resulted from the two phosporus sources were no significantly different, but there was a trend for yield to be higher when concentrated superphosphate was applied (Lutz and Jr, 1971) .

2.3.2. Fruit number :-

Application of phosphorus fertilizers at rates 0, 45 and 90 kg P_2O_5/ha had no significant effect on fruit number of oriental pickling melon (Cucumis melo var. conomon) grown on acid soil contained 86.66 kg P_2O_5/ha of available phosphorus (Hassan et al., 1984) .

Suwwan et al , (1987) found that the application of mono superphosphate at rates 0,100, and 250 kg P_2O_5/ha to calcareous soil (pH 7.8) contained 10.5 P_2O_5 had no significant effect on the number of marketable tomato fruit grown under plastic house in Jordan valley in 1980 and 1981 seasons .

2.3.3. Average fruit weight :-

Application of phosphorus fertilizer at rates 0,45, and 90 kg P_2O_5/ha had no significant effect on average fruit weight of oriental pickling melon (Hassan et al., 1984) . Suwwan et al., (1987) also found that the application of mono superphosphate to soil contained 10.5 ppm of P_2O_5 had no significant effect on average weight of tomato fruit under plastic house condition in Jordan valley .

On other hand , Gibson and Pill, (1983) found that tomato fresh weight increased linearly with phosphorus fertilizer (superphosphate) at rates 0.02, 0.06, 0.18 and 0.53 kg P/m^3 .

2.3.4. Vegetative growth :-

Application of triple superphosphate and liquied phosphoric acid at rates of 0 and 55 kg /ha significantly increased tomato seedling growth as measured by fresh and dry weights at all soil temperature level (Lingle and Davis 1958). On the other hand, Suwwan et al., (1987) found that the application of mono superphophate at rates (0,100, and 250 kg P_2O_5/ha) for tomato plants under plastic house condition had no significant effects on dry weight of vegetative growth of tomato plants .

2.3.5. Total Soluble Solids (TSS%) :-

Application of phosphorus fertilizers at relatively high rate (60 kg P_2O_5/ha) to muskmelon grown in low availabe phosphorus containing (5.7 and 6.1 ppm) acidic soil (pH 6.1 and 6.2) significantly increased total soluble solids in muskmelon fruits from 7.2 to 10.5 percent (Srinivas and Parbhakar, 1984) . Bradley and Fleming (1958), found that total soluble solids in watemelon fruits was lower in case of not applying to the soil either one of N,P or K than in cases of applying combined doses of these nutrient . However, phosphorus application significantly increased total soluble solids .

On the other hand , Srinivas and Parbhakar (1984) obtained different results concerning the effect of phosphorus fertilizers on total soluble solids of watermelon fruits . In 1956 and 1957, they found no significant effects of nitrogen and phosphorus and significant interaction between nitrogen and phosphorus and potassium on soluble solids , but in 1958 there was no significant effect of treatments on the total soluble solids.

2.3.6. Leaf analysis :-

2.3.6.1. Phosphorus leaf concentration :

There have been many reports on the use of foliage analysis as a method for prediciting the response of different crops to fertilizer application . Locascio et al., (1967) found that as the rate of applied phosphorus was increased from 0 to 58kg / ha, phosphorus content of watermelon tissue increased from 0.26 to 0.38% at two locations low in available phosphorus . Further increase in phosphorus application rate resulted in small , but not significant variation in the tissue phosphorus contnet. Locascio et al., (1967) found that phosphorus sources (ordinary superphoshate 8.7%, concnetrated superphoshate 46%, and diammonium phosphate, 18 - 4 - 0) had no significant effect on tissue phosphorus levels . Tyler and Lorenz (1963) found that average leaf phosphorus contet for four muskmelon varieties were about 0.6% and 0.3% in early and late season, respectively .

There was significant differences in foliage of wheat crop phosphorus at the first three sampling dates (45,57 and 80 days after planting) due to application of phosphorus fertilizers , but at the final sampling date there was no significant differences in foliage wheat of crop phosphorus (Bradley and Fleming, 1959 a) .

In the following two successive season these authors found that percentage of phosphorus was affected slightly , but not significantly with application of phosphorus fertilizer.

Several studies showed that application of phosphorus fertilizers at different rates increased phosphorus tissue concentration of several vegetable crops like melon, tomato mustard , bean , potato , and onion (Bradley and Feleming , 1959 b; Lingle , 1960; Paterson et al., 1960; Locascio et al., 1972; Gibson and Pill , 1983; Blatt and McRae, 1986 ; Osawa and Lorenz ,1967).

There was steady and declining trend in phosphorus percentage in watemelon and tomato leaves with the progress of the growing season (Bradley and Fleming, 1959 b; Gibson and Pill , 1983 ; Tyler and Lorenz, 1964) .

Racz and Haluschak, (1974) found that phosphorus concentration in wheat plant increased with incerasing the amount of applied phosphorus fertilzer except in cases when large reduction in yield occurred due to high application rates of phosphorus fertilizer .

2.3.6.2. Micronutrients leaf concentration :

Application of phosphorus fertilizers at different rates had little effect on watermelon tissue -Cu level at the early and flowering stages, but at the mature fruit stage, leaf - Cu was reduced from 4.3 to 3.0 ppm with increasing the rate of applied phosphorus from 0 to 58.26 kg P_2O_5/ha (Locascio et al., 1967) .

Zinc and copper uptake and accordingly their concentration in wheat plants were usually greater for plants grown in low phosphorus solution than for plants grown in high phosphorus solution.

Manganese uptake and concentration in wheat plants increased when small amount of phosphorus were added, but then decreased with further addition of phosphorus (Racz and Haluschak, 1974) .

In several instances , iron uptake and the subsequent concentration in wheat were also reduced by high phosphorus concentration . (Racz and Haluschak, 1974) . These authors concluded that the micronutrient reduction with increasing phosphorus concentration in the soil had been attributed to the immobolization of micronutrient in the soil by phosphorus precipitation and indicated that the phosphorus - micronutrient interactions were physiological in nature due to root surface absorption phenomena or reduced translocation within the plant .

3. MATERIALS AND METHODS

3.1 Experimental design and phosphorus treatments :-

Field experiments were carried out during the growing season of summer of 1989 in the Jordan Valley at two locations , Jordan University Farm and Deir Alla Agricultural Research Station .

The experimental design was split-plot with 3 replicates. Main plots were assigned to phosphorus source treatments (Triple superphosphate (TSP) 46% P_2O_5 and Rock phosphate (RP) 32% P_2O_5) , sub-plots were assigned to phosphorus rate (0, 50 , 100, 150 , 200 and 250 kg P_2O_5/ha) from each source.

Each treatment consisted of six rows, each being 3 m long, with seed sets at 0.5 m spacing along row . Rows were 2 m apart . The distances between treatments in the same replicate , and between replicates were 1 and 2 m respectively, ending up to a total area of 1248 m^2.

The layouts of both trails are shown in appendix II (Figures 1 and 2) .

3.2. Agricultural Practices :-

In both experimental locations, the soil was plowed two times, rotivated and leveled, one third of the nitrogen quantity (250 kg ammonium sulfate/ ha) along with the entire dose of phosphonus fertilizer were mixed and applied in shallow band along the lateral of the drip irrigation lines in the University Farm location , and in the bottom of the furrows in Deir Alla location prior to seed planting, plastic mulch was used to cover individual rows of each treatment in University Farm location .

Three seeds of Palmyra F1 Hybrid muskmelon cultivar (produced by Nickerson Zwaan) were planted on April 1 and April 3 , 1989 in Deir Alla and University Farm location, respectively in each hole. The plants were thinned to one plant per hole two weeks after planting. Drip and furrow irrigation were used in the University Farm and the Deir Alla location , respectively. Irrigation commenced at time of planting and continued two times weekly throughout the growing season. The N-fertilizer was added in three equal doses at planting time (mixed with the entire doeses of phosphorus treatments) and two times after with one month interval.

The plants were drenched with the fungicide Tashgrin (40 cm^3/20 litters of water) two times after planting to avoid fusarium wilt. Protection against insects was accomplished by spraying of Torque (40 gm/20 litters of water) , Danitol and Phosdrine (25 cm^3/20 litters of water) on a weekly schedule to control aphides , mites and other possible attack of insects .

3.3. Data collection :

The collected data were taken from the four middle rows as follows :

3.3.1. Collection. Preparation and Analysis of Soil Samples :

Representative composite surface soil samples were collected from the two locations, before the application of phosphorus treatments . Samples were then analysed for pH , electrical conductivity (E.C) in paste extract , Na HCO_3 extractable - P using the colorimetric Olsen methoed , organic matter, Ca CO_3 content and particle size distribution (Walsh and Beaton, 1980) (Table1) . At the end of the growing seasons , representative composite soil samples were collected from the top 30 cm from each P - treatment (24 locations in each plot) .

The samples were mixed thoroughly , air dried and gently ground to pass a 2 mm screen. The samples were analyzed for $NaHCO_3$ - extractable- P using Olsen method .

3.3.2. Yield :-

Ripe muskmelon fruits were harvested at the full - slip stage from June 5 to July 4 from the 24 plants from each treamtnet, 3 - 4 day intervals throughout the harvest season .

Yield and number of marketable and unmarketable fruits as well as the average weight of individual fruit and average fruit number per plant were reported . Unmarketable fruits included decayed , sun burn, misshapened fruits.

3.3.3 Total Soluble Solids :-

At the harvest time, at least 10 melons per plot were randomely picked for the determination of total soluble solids . Fruits that were rated as overripe

Table (1) Some properties of the soils used in Deir Alla and University Farm .

Location	Particle size distribution sand %	silt %	clay %	$CaCO_3$ eqiv. %	Organic matter %	N %	pH	E.C	Available phosphorus (ppm)
Deir Alla	22.5	45	32.5	30.32	1.5	0.074	8.1	1.6	14
University Farm	62.50	25	12.5	28.68	0.8	0.776	8.2	1.7	16

or underripe were not considered in the determination of soluble solids. Soluble solids were determined with electrical refractometer from the juice obtained from the flesh of muskmelon fruit.

3.3.4. Vegetative Growth :-

At the end of the harvest season, plants from each plot were cut down close to the soil surface and weighed to determine the vegetative fresh weights Representative plant samples (one Kg fresh weight) from each plot were oven dried at 68C° to constant weight to determine the dry weight. Fresh and dry weight were calculated per plant.

3.3.5. Collection, Preparation and Analysis of Leaf Samples :

Mature leaf samples were taken for chemical analysis two times ; one month after planting, from nodes 2 - 4 on the main stem and; two months after planting, from nodes 9 and 10 on the main stem because the tissues that are physiologically young undergo rapid changes in nutrient composition. Leaf samples were washed in distilled water to remove dust deposited on the surface. These samples were oven dried at 68°C for 48 hours to constant weight, and ground to reduced the material to a fineness suitable for analysis using a mechanical grinding.

The ground leaf samples were stored in air tight plastic containers for a later chemicl determination. One gram dry weight leaf samples was placed in porcelain dish, put into oven and ashed at 550°C for 4 hours, the ash was dissolved in 1 N HCl. Phosphorus was determined by using the colorimetric Olsen method and Cu, Fe, Zn and Mn by atomic absorption technique , two times . All values were reported on a dry weight basis .

All results were statistically analysed as for the split - plot design as describerd by (Little and Hills , 1977) .

4. RESULTS AND DISCUSSION

4.1 Effect of phosphorus source, rate, and their interaction on:-

4.1.1. $NaHCO_3$- extractable soil phosphorus :

The effect of phosphate treatments on $NaHCO_3$ - extractable soil phosphorus at the end of the growing season are shown in tabel (2).

In both locations , rock phosphate application have less impact on $NaHCO_3$ - extractable soil phosphorus than did triple superphosphate. Increasing phosphorus application rates significantly increased available soil phosphorus from 13.8 to 34.2 and from 15.0 to 34.6 ppm in Deir Alla and University Farm locations, respectively.

There was significant interaction between phosphorus source and rate on the available soil phoshorus (Table 2) . In both locations, the intermediate rates of triple superhosphate (100 and 150 kg P_2O_5/ha) raised the available soil phosphorus above that produced by higher rates of rock phosphate (200 and 250 kg P_2O_5/ha) .

From these results, rock phosphate seemed to be less effective in increasing the available soil phosphorus than did triple superphoshate under

Table (2) : Effect of phosphorus source, rate, and their interaction on $NaHCO_3$- exteractable soil phosphorus at the end of the growing season in Deir Alla and University Farm , 1989.

$NaHCO_3$ - extractable soil phosphours (ppm)						
	Deir Alla			University Farm		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source **					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	14.3 gh*	13.3 H	13.8 e	15.0 g	15.0 g	15.0 f
50	22.7 ef	16.7 gh	19.2 d	18.3 fg	18.0 fg	18.2 e
100	25.0 de	19.0 fg	22.0 d	25.2 d	21.2 ef	23.2 d
150	30.0 be	23.3 ef	26.7 c	29.2 c	24.5 de	26.8 c
200	34.0 b	26.0 cde	30.0 b	33.7 b	28.7 c	31.2 b
250	40.0 a	28.3 cd	34.2 a	38.0 a	31.3 bc	34.7 a
Source mean	27.5 a	21.1 b		26.5 a	23.1 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

the experimental soil conditions may be due to high Ca content of rock phosphate, high Ca content in soil solution as well as high carbonate content of soil. However, triple superphosphate application at different rates increased the available soil phosphorus two times more than the available soil phosphorus produced by rock phosphate application at the same rate of P_2O_5.

These results come in agreement with earlier studies , soil pH has indentified as the most important soil factor influencing availability of phosphorus from rock phosphate . Archer (1978) reported that Gafsa rock phosphate , where the soil pH was initially above 6.0, was not effective as the more soluble forms of phosphours fertilizers in increasing the available soil phosphorus. Kittams and Attoe (1965) reported that pH of calcareous soils is unfavorable for conversion of elemental phosphorus of rock phosphate to more soluble forms. In calcareous soils, phosphorus supplied by phosphorus fertilizers is subject to fixation (Follett et al., 1981). Simard et al., (1988 a,b) reported a general decrease in $NaHCO_3$- extractable phosphorus as the rate of $CaCO_3$ addition increased . The mechanisim that can be suggested to explain the effect of $CaCO_3$ addition on the extractability of phosphorus by $NaHCO_3$- was that the addition of $CaCO_3$ could have increased Ca fraction on the exchange sites of the extractability of phosphorus, which increased the precipitation of phosphorus as :

$$Ca\,(H_2PO_4)_2 + 2\,Ca^{++} \rightarrow Ca_3\,(PO4)_2 + 4H^+$$

(soluble) (insoluble)

Lajtha and Bloomer (1988) and Chien (1978) , also found that a strong correlation between phosphorus adsorption and soil $CaCO_3$. Our results also are in agreement with results of earlier studies about the low availability of phosphorus from rock phophate in calcareous soils which may be due to high Ca content of rock phosphate, high Ca content in soil solution as well as high carbonate content of soil .

On the other hand, rock phosphate application to acidic soil (soil pH was less than 6.0) was equal or more effective than more soluble forms of phosphours fertilizers Chien (1978); Archer (1978); Jones (1982). Chien (1978) reported that the residual available phosphorus of Gafsa rock phosphate in acidic soil was more effective than triple superphosphate to plant.

Also , Archer (1978) reported that the residual effects of the rock phosphate on acidic soil was almost as greet as those from superphosphate, although it remained of little value for grass on neutral soils .

In acidic soil, rock phosphate was applied as phosphorus source and soil amedment because the rock phosphate increase soil Ca content, soil phosphorus and increase soil, pH , also decreased the lime requirment .

In neutral and alkali soils , rock phosphate application was less effective than superphosphate, but the partially acidulation of rock phosphate or granulated with sulfer could increas the effectiveness.

4.1.2. Yield:

In both locations , no significant effect of phosphorus source and rates on marketable, unmarketable and total yield of muskmelon. (Tables 3,4 and5). This may be due to high level of initial soil phosphorus and the low requirment of muskmelon to phosphorus fertilizers .

These results come in agreement with Suwwan et al., (1987) who reported that phosphorus application at rates 0,100 and 250 kg P_2O_5/ha for plastic house tomato grown in similar soil conditions of the present study had no significant effect on tomato yield.

Yield of muskmelon grown in University Farm location, showed a slight reduction trend with increasing phosphorus rate , but not in Deir Alla location. In regard to phosphours treatments , marketable and total muskmelon yield were higher in the University Farm location than in the Deir Alla location . This may be due to differences in irrigation system and the vine vigor in University Farm location was better than Deir Alla location .

Several studies (Locascio et al., 1967; Hasan et al., 1984; Srinivas and Parbhakar, 1984) showed that various sources and rates of phosphorus fertilizers resulted in different yield responses in several cereal and vegetable crops, depending on initial level of available soil phosphorus, other soil conditions, and plant requirements .

Table (3) : Effect of phosphorus source, rate, and their interaction on muskmelon yield in Univesity Farm and Deir Alla, 1989.

Total Yield (tons / ha)						
	University Farm			Deir Alla		
Phosphorus rate	Phosphorus Source**					
P_2O_5Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	16.60 a*	16.31 a	16.45a	12.39 a	12.50 a	12.45 a
50	16.85 a	15.25 a	16.05a	12.92 a	13.22 a	13.07 a
100	16.09 a	16.51 a	16.30a	13.47 a	12.60 a	13.04 a
150	16.05 a	14.72 a	15.39a	12.69 a	13.13 a	12.91 a
200	15.61 a	15.95 a	15.78a	13.01 a	13.64 a	13.32 a
250	15.78 a	15.65 a	15.72a	12.62 a	12.99 a	12.80 a
Source mean	16.16 a	15.73 a		12.85 a	13.01 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate ..

Table (4) : Effect of phosphorus source, rate, and their interaction on marketable muskmelon yield in Univesity Farm and Deir Alla , 1989.

Phosphorus rate P_2O_5 Kg/ha	Marketable yield (tons/ha)					
	University Farm			Deir Alla		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	14.68 a*	14.18 a	14.43 a	10.43 a	10.49 a	10.46 a
50	15.17 a	13.30 a	14.24 a	11.05 a	11.06 a	11.05 a
100	13.84 a	14.27 a	14.05 a	11.48 a	10.59 a	11.04 a
150	14.07 a	13.22 a	13.64 a	10.78 a	11.19 a	10.98 a
200	14.54 a	13.85 a	14.20 a	11.26 a	11.57 a	11.41 a
250	13.60 a	13.84 a	13.72 a	10.74 a	11.04 a	10.89 a
Source mean	14.32 a	13.77 a		10.96 a	10.99 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (5) : Effect of phosphorus source, rate, and their interaction on unmarketable muskmelon yield in University Farm and Deir Alla , 1989.

Unmarketable Yield (tons/ha)						
	University Farm			Deir Alla		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source** TSP	RP	Rate mean	TSP	RP	Rate mean
0	1.92 a*	2.13 a	2.02 a	1.97 a	2.01 a	1.99 a
50	1.67 a	1.95 a	1.81 a	1.87 a	2.16 a	2.02 a
100	2.25 a	2.24 a	2.25 a	1.99 a	2.01 a	2.00 a
150	1.98 a	1.51 a	1.74 a	1.91 a	1.93 a	1.99 a
200	1.07 a	2.10 a	1.58 a	1.75 a	2.14 a	1.94 a
250	2.18 a	1.82 a	2.00 a	1.87 a	1.95 a	1.91 a
Source mean	1.84 a	1.96 a		1.89 a	2.03 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

The results obtained in the current study are in agreement with the findings of Locascio et al., (1967) who reported that further increased in phosphorus application rates beyond 116 kgP/ha resulted in small variation in watermelon yield . In addition, watermelon yield was reduced as the rate of phosphorus application increased when no Cu-fertilizer was applied . Also , these results agreed with these of Hassan et al., (1984) who reported that phosphorus level had no significant effect on the yield of oriental pickling melon grown in soil of high level of available phosphorus.

Blatt and McRae (1986) mentioned that progressively higher application rates of phosphorus caused a progressive decline in tomato yield in soil of high phosphours (350 - 500 kg/ha) , but in sites of low available phosphorus (85-100 kg/ha) , application of P - fertilizer increased tomato yield. Also Nishimato et al., (1977) indicated that for most vegetable crops (cabbage , sweet potato, lettuce and tomato) the yield curves indicating a trend toward depressed yield at the highest phosphorus concentration in soil solution (above 0.4 ppm) .

Gibson and Pill (1983) ; Bradley and Fleming (1958) and Sriniva Parbhakar (1984) reported that phoshorus fertilizers application increased the yield of tomato , watermelon and muskmelon grown in soils of low available phosphorus .

4.1.3. Fruit number:-

In both locations, unmarketable, marketable and total fruit numbrer of muskmelon were not significantly affected by phosphorus source and rates, also their interactive effects were not significant (Tables 6,7 and 8) .

These results come in agreement with Hassan et al., (1984) and Suwwan et al., (1987) who reported that phosphorus application at different rates had no significant effects on fruit number of oriental pickling melon and tomato growing in plastic house, respectively .

Table (6) : Effect of phosphorus source, rate, and their interaction on total muskmelon fruit number in University Farm and Deir Alla, 1989 .

Fruit number / ha						
	University Farm			Deir Alla		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	19167 a*	18333 a	18750 a	12917 b	13194 ab	13056 b
50	17500 a	17778 a	17639 a	14167 ab	14861 a	14514 a
100	18472 a	19167 a	18819 a	14306 ab	14028 ab	14167 ab
150	17778 a	15972 a	16875 a	13472 ab	14305 ab	13889 ab
200	17500 a	17222 a	17361 a	13472 ab	14722 ab	14097 ab
250	18194 a	17361 a	17778 a	13333 ab	14444 ab	13889 ab
Source mean	18102 a	17639 a		13611 a	14259 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (7) : Effect of phosphorus source, rate, and their interaction on marketable number of muskmelon fruit in University Farm and Deir Alla, 1989.

Phosphorus rate P_2O_5Kg/ha	Number of marketable fruit / ha					
	University Farm			Deir Alla		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	15278 a*	14583 a	14931 a	10417 a	10139 a	10278 a
50	14861 a	14444 a	14653 a	11667 a	11805 a	11736 a
100	14583 a	15556 a	15069 a	11528 a	11111 a	11319 a
150	14583 a	13472 a	14027 a	10694 a	11667 a	11181 a
200	15139 a	14027 a	14583 a	11250 a	11944 a	11597 a
250	14166 a	14167 a	14167 a	10555 a	11805 a	11181 a
Source mean	14769 a	14375 a		11019 a	11412 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (8) : Effect of phosphorus source, rate, and their interaction on unmarketable number of muskmelon fruit in University Farm and Deir Alla, 1989.

	Number of unmarketable fruit /ha					
	University Farm			Deir Alla		
Phosphorus rate	Phosphorus Source**					
P_2O_5Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	3889 a*	3750 a	3819 a	2500 a	3056 a	2778 a
50	2639 a	3333 a	2986 a	2500 a	3056 a	2778 a
100	3889 a	3611 a	3750 a	2778 a	2917 a	2847 a
150	3194 a	2500 a	2847 a	2778 a	2639 a	2708 a
200	2361 a	3194 a	2778 a	2222 a	2778 a	2500 a
250	4023 a	3194 a	3611 a	2778 a	2639 a	2708 a
Source mean	3333 a	3264 a		2593 a	2847 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

4.1.4. Average fruit number per plant :-

In both locations, phosphorus source had no significant effect on average fruit number per plant, also in University Farm location, phosphorus rate had no significant effect on average fruit number per plant (Table 9) .

In Deir Alla location, the treatments of 100 and 200kg P_2O_5/ha, regardless of phosphorus source, produced significantly higher average fruit number per plant compared with zero kg P_2O_5/ha (Table 9) .

Application of rock phosphate at the rate of 200kg P_2O_5/ha, produced significanlty higher average fruit number per plant in Deir Alla location than did application rates of triple superphosphate and rock phosphate (Table 9) .

These results are in agreement with the findings of Hassan et al (1984) and Suwwan et al., (1987) who reported that phosphorus application at different rates had no significant effects on fruit number of oriental pickling melon and tomato, respectively .

Table (9) : Effect of phosphorus source, rate, and their interaction on average muskmelon fruit number per plant in University Farm and Deir Alla, 1989 .

Average fruit number / plant						
	University Farm			Deir Alla		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	1.92 a*	1.83 a	1.86 a	1.29 b	1.31 b	1.30 b
50	1.75 a	1.78 a	1.76 a	1.38 ab	1.41 ab	1.40 ab
100	1.75 a	1.92 a	1.83 a	1.43 ab	1.40 ab	1.41 a
150	1.78 a	1.60 a	1.89 a	1.34 ab	1.43 ab	1.39 ab
200	1.75 a	1.72 a	1.74 a	1.34 ab	1.47 a	1.41 a
250	1.82 a	1.74 a	1.78 a	1.33 ab	1.44 b	1.38 ab
Source mean	1.79 a	1.76 a		1.35 a	1.41 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

4.1.5 Average Fruit weight :-

In University Farm location, phosphorus source and rates did not significantly affect average weight of muskmelon fruit (Table 10) .

In Deir Alla location , average weight of muskmelon fruit produced by triple superphosphate was significantly higher than rock phosphate application. In addition, among all the triple superphosphate treatments, the 0 and 200 kg P_2O_5/ha, gave significantly higher average fruit weight than that from 50, 100 and 250 kg P_2O_5/ha, of rock phosphate (Table 10) .

The results of Deir Alla location, come in disagreement with results of Hassan et al., (1984) and Suwwan et al., (1987) who reported that phosphorus application at different rates had no significant effect on average weight of oriental pickling melon and plastic house tomato, respectively. However, the results of University Farm location , were in agreement with the above findings.

Table (10) : Effect of phosphorus source, rate, and their interaction on average weight of muskmelon fruit in University Farm and Deir Alla , 1989.

Phosphorus rate P_2O_5Kg/ha	Average fruit weight (kg) — University Farm — Phosphorus Source** TSP	RP	Rate mean	Deir Alla TSP	RP	Rate mean
0	0.86 a*	0.89 a	0.88 a	0.96 a	0.95 ab	0.95 a
50	0.96 a	0.86 a	0.91 a	0.92 ab	0.90 b	0.91 b
100	0.87 a	0.86 a	0.87 a	0.94 ab	0.90 b	0.92 ab
150	0.91 a	0.92 a	0.91 a	0.94 ab	0.92 ab	0.93 ab
200	0.89 a	0.93 a	0.91 a	0.97 a	0.92 ab	0.94 ab
250	0.87 a	0.90 a	0.889 a	0.95 ab	0.90 b	0.92 ab
Source mean	0.89 a	0.89 a		0.95 a	0.91 b	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

4.1.6. Vegetative growth :-

Fresh weight of vegetative parts per muskmelon plant was not significantly affected by phosphorus source and rates in both locations (Table 11 and 12). However, in the Univesity Farm location, the highest rate application of phosphorus fertilizer significantly increased dry weight of muskmelon plant than zero and other treatments (Table 12) . On the other hand , in Deir Alla location, dry weight was not significantly affect by phosphorus source and rates.

These results were in agreement with the findings of Suwwan et al., (1987) who reported no significant effect on dry weight of tomato vegetative grwoth under plastic house conditions when applying mono superphosphate fertilizer at rate 0,100 and 250 kg P_2O_5/ha .

These results are not in agreement with Lingle (1960) who reported that triple superphosphate phosphorus fertilizer and liquid phosphoric acid significantly increased tomato seedling grwoth as measured by both fresh and dry weight .

Table (12) : Effect of phosphorus source, rate, and their interaction on dry weight of muskmelon plants in University Farm and Deir Alla,1989 .

Dry weight of vegetative growth (gm/plant)						
	University Farm			Deir Alla		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	192.66 c*	196.19 abc	194.42bc	145.57ab	150.13ab	147.85 a
50	195.42 abe	194.14 bc	194.78bc	147.72ab	148.94ab	148.33 a
100	198.34 ab	196.73 abc	197.54ab	147.77ab	150.15ab	148.96 a
150	193.09 c	195.41 abc	194.25c	145.30b	150.19ab	147.75 a
200	198.32 ab	195.57 abc	196.95abc	145.86ab	149.93ab	147.90 a
250	199.28 a	198.24 ab	198.76a	150.17ab	151.29a	150.73 a
Source mean	196.18 a	196.05a		147.07 a	150.11 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

4.1.7. Total Soluble Solids :

There was no significant difference in total soluble solids in muskmelon fruit due to phosphorus source in the two locations (Table 13) .

In regard to phosphorus source , phosphorus rates significantly increased the total soluble solids per cent from 7.96 to 8.60% and from 8.23 to 8.89% in University Farm and Deir Alla locations , respectively. These results come in agreement with Srinivas and Prabhaker (1984) who reported that in soil having low available phosphorus, application of higher phosphorus rate (60 kg P_2O_5/ha,) increased total soluble solids of muskmelon fruits from 7.3 to 10.5%. Similarly , Bradley and Fleming (1958) found that phosphorus fertilizers increased total soluble solids in watermelon fruit. However, Srinivas et al., (1984) found that no significant effects of phosphorus fertilizers application on total soluble soilds of watermelon fruit .

Table (13) : Effect of phosphorus source, rate, and their interaction on total soluble solids percent of muskmelon fruit in University Farm and Deir Alla,1989.

Total soluble solids (%)						
	University Farm			Deir Alla		
Phosphorus rate	Phosphorus Source**					
P_2O_5Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	8.03 bc*	7.89 c	7.96 c	8.32 de	8.13 e	8.23 d
50	8.13 abc	8.19 abc	8.18 bc	8.48 bcde	8.38 cde	8.43 cd
100	8.41 ab	8.22 abc	8.31 ab	8.50 bcde	8.40 cde	8.45 cd
150	8.63 a	8.27 abc	8.45 a	8.68 abcd	8.57 abcd	8.63 bc
200	8.44 ab	8.57 a	8.51 a	8.75 abc	8.87 ab	8.81 ab
250	8.56 a	8.64 a	8.60 a	8.92 a	8.87 ab	8.89 a
Source mean	8.38 a	8.30 a		8.61 a	8.54 a	

* Means for each location with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

4.1.8. Leaf analysis :-

4.1.8.1. Phosphorus content of muskmelon leaves :

In both locations, phosphorus source had no significant effects on phosphorus content of muskmelon leaves at 30 and 60 days after planting (Table 14 and 15).

Significant differences in foilar phosphorus resulted from phosphorus rates application at the two sampling dates in Deir Alla location Table (15) and the phosphorus leaf content ranged from 0.468 to 0.495 and from 0.317 to 0.338% at the two sampling dates, respectively.

Application of phosphorus fretilizers at rates 100, 150, 200 250 kg P_2O_5/ha, produced significantly higher leaf-P% than did the 0. and 50 kg P_2O_5/ha, treatments at 30 days after planting in Deir Alla location (Table 15).

Phosphorus application rate 50 kg P_2O_5/ha, at 60 days after planting produced significanlty higher leaf-P% than did zero, but the application of higher phosphorus rates did not significantly differ for Deir Alla location (Table15) .

In University Farm location , the foliar phosphorus content increased with increasing the application rates of phosphorus , but the differences were not significant and the tissue phosphorus contnet ranged from 0.438 to 0.477% and from 0.295 to 0,315% at the two sampling dates , respectively. (Table 14).

Our results showed a steadily decreasing trend in leaf-P% with progression of season at two location .

Table (14) : Effect of phosphorus source, rate, and their interaction on phosphorus content of muskmelon leaves 30 and 60 days after planting in University Farm , 1989 .

P% of muskmelon leaves						
	P% 30 days after planting			P% 60 days after planting		
Phosphorus rate	Phosphorus Source**					
P_2O_5Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	0.427 b*	0.450 ab	0.438 a	0.303 a	0.287 a	0.295 a
50	0.447 ab	0.433 b	0.440 a	0.323 a	0.300 a	0.312 a
100	0.437 b	0.480 ab	0.458 a	0.297 a	0.293 a	0.295 a
150	0.447 ab	0.507 a	0.477 a	0.320 a	0.300 a	0.310 a
200	0.453 ab	0.483 ab	0.468 a	0.297 a	0.313 a	0.305 a
250	0.440 ab	0.470 ab	0.455 a	0.290 a	0.327 a	0.308 a
Source mean	0.442 a	0.470 a		0.305 a	0.303 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (15) : Effect of phosphorus source, rate, and their interaction on phosphorus content of muskmelon leaves at 30 and 60 days after planting in Deir Alla,1989 .

Phosphorus rate P_2O_5Kg/ha	P% of muskmelon leaves					
	30 days after planting			60 days after planting		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	0.483 abcd*	0.457 d	0.470 b	0.333 b	0.300 c	0.317 b
50	0.477 bcd	0.460 cd	0.468 b	0.360 a	0.317 bc	0.338 a
100	0.510 a	0.483 abcd	0.497 a	0.330 b	0.313 bc	0.322 ab
150	0.507 ab	0.490 ab	0.498 a	0.337 ab	0.320 bc	0.328 ab
200	0.503 ab	0.487 abc	0.495 a	0.320 bc	0.323 bc	0.322 ab
250	0.507 ab	0.490 ab	0.498 a	0.333 b	0.310 bc	0.322 ab
Source mean	0.498 a	0.478 a		0.336 a	0.314 a	

* Means for each samoling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Locascio et al., (1971) reported that as the rate of applied phosphorus increased from 0 to 58.26 kg/ha , phosphorus of the watermelon tissue increased from 0.26 to 0.38% at two locations low in available phosphorus. They also found that further increase in phosphorus rate application resulted in small increase in watermelon tissue-P%, but not significant.

Our results were also agreement with the findings of Tyler and Lorenz (1963) who reported that leaf- P contents of four muskmelon varieties were about 0.60 and 0.30% for early and late in the growing season , respectively. Bradley and Fleming (1959) observed a steady declining trend of P% of watermelon leaves as the growing season progressed . Gibson and Pill (1983) reported that phosphorus concentration in tomato leaves increased with increasing phosphorus application rate to the soil . In addition, phosphorus concentration in watermelon and tomato seedlings tended a slight increase early in the season then the concentration decreased with the advancement in plant age .

There was an increased in concentration of tissue - P of melon , tomato seedling, mustard, bean , potato and onion due to application of phosphorus fertilizers (Blatt and MCRac (1986) ; Bradley and Fleming (1959 a) ; Lingle (1960) ; Locascio et al., (1972) ; Paterson et al., (1960)) .

4.1.8.2 Micronutrient content in muskmelon leaves :-

Zinc : Application of rock phosphate to the soil in University Farm location , significantly increase zinc concentration in muskmelon leaves than did triple superphosphate at 30 days after planting (Table 16) . However, there was no significant differences in zinc concentration of muskmelon leaves at Deir All location (Table 17). Application of higher rates of phosphorus significanlty decreased zinc concentration in muskmelon leaves at 30 and 60 days after planting in University Farm location and at 30 days after planting in Deir Alla location (Table 16 and 17) .

Copper : Application of phosphorus source had no significant effect on copper concntration in muskmelon leaves at the two stages of plant growth in both locations (Table 18 and 19). Moreover, rock phosphate application increased copper concentration in muskmelon leaves collected 60 days after planting in Deir Alla location (Table 18 and 19). A reduction in copper concentration in the muskmelon leaves as the rate of phosphorus increased at the two growing stages in the two locations (Table 18 and 19) . These results were in agreement with the results of Racz and Haluschak (1974) who reported that Zn and Cu concentration in wheat plant and the uptake of these micronutrients were greater for plants growing in low phosphorus solution than in plant growing in solutions of higher concentration of phosphorus

Iron: In University Farm location, phosphorus source and rates had no

Table (16) : Effect of phosphorus source, rate, and their interaction on zinc content of muskmelon leaves at 30 and 60 days after planting in University Farm ,1989 .

Zinc content of muskmelon leaves (ppm)						
	30 days after planting			60 days after planting		
Phosphorus rate P_2O_5Kg/ha	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	25.0 abc*	25.7 ab	25.3 ab	26.7 bcd	28.0 abc	27.3 a
50	25.3 abc	26.7 a	26.0 a	25.3 de	30.0 a	27.7a
100	23.3 bcd	25.3 abc	24.3 ab	25.3 de	28.3 ab	26.8 ab
150	23.0 bcd	24.7 abc	23.8 bc	25.7 cde	25.3 de	25.5 bc
200	22.7 cd	25.3 abc	24.0 bc	25.0 de	26.0 bcde	25.5 be
250	21.7 d	23.7 bcd	22.7 c	24.0 e	25.0 de	24.5 c
Source mean	23.5 b	25.2 a		25.3 a	27.1 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (17) : Effect of phosphorus source, rate, and their interaction on zinc content of muskmelon leaves at 30 and 60 days after planting in Deir Alla,1989 .

Zinc content of muskmelon leaves (ppm)						
	30 days after planting			60 days after planting		
Phosphorus rate	Phosphorus Source**					
P_2O_5 Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	25.3 ab*	26.3 ab	25.8 ab	24.3 a	23.7 a	24.0 a
50	26.7 a	26.7 a	26.7 a	24.0 a	23.3 a	23.7 a
100	25.7 ab	25.3 ab	25.5 ab	22.6 a	24.3 a	23.5 a
150	26.0 ab	25.7 ab	25.8 ab	24.3 a	24.7 a	24.5 a
200	25.7 ab	24.7 b	25.2 b	23.3 a	24.3 a	23.8 a
250	25.0 ab	24.7 b	24.8 b	23.0 a	22.7 a	22.8 a
Source mean	25.7 a	25.6 a		23.6 a	23.8 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (18) : Effect of phosphorus source, rate, and their interaction on copper content of muskmelon leaves at 30 and 60 days after planting in University Farm,1989.

Phosphorus rate P_2O_5Kg/ha	Copper content of muskmelon leaves (ppm) – 30 days after planting – Phosphorus Source** TSP	RP	Rate mean	60 days after planting – TSP	RP	Rate mean
0	13.3 a*	13.0 ab	13.2 a	11.7 ab	11.7 ab	11.7 a
50	12.7 ab	13.0 ab	12.8 ab	12.3 a	11.0 ab	11.7 a
100	11.3 c	13.0 ab	12.2 b	12.0 ab	10.7 b	11.3 a
150	12.3 abc	12.3 abc	12.3 b	11.0 ab	11.0 ab	11.0 a
200	12.3 abc	12.0 bc	12.2 b	11.7 ab	10.7 b	11.2 a
250	12.3 abc	12.3 abc	12.3 b	10.7 b	10.7 b	11.7 a
Source mean	12.4 a	12.6 a		11.6 a	10.9 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (19) : Effect of phosphorus source, rate, and their interaction on copper content of muskmelon leaves at 30 and 60 days after planting in Deir Alla,1989.

Phosphorus rate P_2O_5Kg/ha	Copper content of muskmelon leaves (ppm)					
	30 days after planting			60 days after planting		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	9.7 a*	8.7 abc	9.2 a	9.3 ab	10.3 a	9.8 a
50	9.3 ab	8.3 bc	8.8 ab	8.0 cd	10.0 a	9.0 b
100	8.7 abc	8.0 c	8.3 b	8.7 bc	9.3 ab	9.0 b
150	9.0 abc	9.0 abc	9.0 ab	8.0 cd	8.7 bc	8.3 bc
200	8.7 abc	8.3 bc	8.5 ab	7.7 cd	8.3 bcd	8.0 c
250	8.3 ab	8.3 bc	8.3 b	7.3 d	8.0 cd	7.7 c
Source mean	8.9 a	8.4 a		8.2 a	9.1 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (20) : Effect of phosphorus source, rate, and their interaction on iron content of muskmelon leaves at 30 and 60 days after planting in university Farm, 1989 .

Phosphorus rate P_2O_5Kg/ha	Iron content of muskmelon leaves (ppm)					
	30 days after planting			60 days after planting		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	97.7 a*	96.3 a	97.0 a	108.0 a	98.7 a	103.3 a
50	92.7 a	95.0 a	93.8 a	108.0 a	102.3 a	105.2 a
100	93.0 a	97.0 a	95.0 a	104.0 a	103.3 a	103.7 a
150	101.0 a	97.3 a	99.2 a	101.3 a	107.3 a	104.3 a
200	98.3 a	96.3 a	97.3 b	99.3 a	104.0 a	101.7 a
250	98.3 a	98.6 a	98.5 b	97.7 a	96.0 a	97.7 a
Source mean	96.8 a	96.8 a		103.1 a	102.6 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (21) : Effect of phosphorus source, rate, and their interaction on iron content of muskmelon leaves at 30 and 60 days after planting in Deir Alla,1989 .

Phosphorus rate P_2O_5Kg/ha	Iron content of muskmelon leaves (ppm)					
	30 days after planting			60 days after planting		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	164.7 abc*	171.0 ab	167.8 a	85.0 c	98.7 abc	91.8 b
50	167.7 abc	166.3 bc	167.0 a	96.0 abc	92.7 abc	94.3 b
100	163.0 abc	178.3 a	170.7 a	90.7 bc	94.3 abc	92.5 b
150	158.7 abc	168.7 abc	163.7 a	101.0 abc	102.0 abc	101.5 ab
200	145.3 c	167.3 abc	156.3 ab	111.3 a	88.3 bc	99.8 ab
250	147.7 bc	145.0 c	146.3 b	110.7 a	106.3 ab	108.5 a
Source mean	157.8 a	166.1 a		99.1 a	97.1 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

significant effect on iron concentration in the muskmelon leaves at 30 and 60 days after planting (Table 20) .

In Deir Alla location, phosphorus source had no significant effect on Fe concentration in muskmelon leaves at 30 and 60 days after planting (Table 21) .

In Deir Alla location, and at 30 days after planting, higher phosphorus rates significantly reduced the Fe concentration in muskmelon leaves, while at 60 days after planting, higher phosphorus rates increased Fe concentration in muskmelon leaves (Table 22) .

These results are in agreement with the findings of Racz and Haluschak (1974) who reported that iron concentration in wheat tissues and uptake of that nutrient were reduced due to high phosphorus concentration in the soil .

Manganese : In both locations , phosphorus source had no significant effect on Mn concentration in muskmelon leaves at 30 and 60 days after planting (Table 22 and 23) .

In general, leaf - Mn was lower in the case of applying triple superphosphate than that of rock phosphate , although the differences were not significant (Table 22 and 23) .

These results are in agreement with the results reported by Racz and haluschak (1974) who indicated that Mn uptake and accumulation in wheat tissues increased when small amount of phosphorus was added to the soil, but decreased with the addition of phosphorus at relatively higher rates .

Locascio et al., (1967) reported that excessive phosphours supplied to the

Table (22) : Effect of phosphorus source, rate, and their interaction on manganese content of muskmelon leaves at 30 and 60 days after planting in University Farm,1989 .

Phosphorus rate P_2O_5Kg/ha	Manganese content of muskmelon leaves (ppm)					
	30 days after planting			60 days after planting		
	Phosphorus Source**					
	TSP	RP	Rate mean	TSP	RP	Rate mean
0	59.0 abc*	59.0 abc	59.0 a	70.0 ab	60.0 b	65.0 bc
50	55.0 bc	67.3 a	61.2 a	73.0 a	71.7 a	72.8 ab
100	58.3 abc	60.0 abc	59.2 a	74.3 a	73.3 a	73.8 a
150	58.7 abc	62.3 ab	60.5 a	68.0 ab	71.0 ab	69.5 abc
200	54.3 bc	58.0 abc	56.2 a	70.0 ab	70.7 ab	70.3 abc
250	49.0 c	58.3 abc	53.7 a	67.0 ab	59.7 a	63.3 c
Source mean	55.7 a	60.8 a		70.4 a	67.7 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

Table (23) : Effect of phosphorus source, rate, and their interaction on manganese content of muskmelon leaves 30 and 60 days after planting in Deir Alla,1989.

Manganese content of muskmelon leaves (ppm)						
	30 days after planting			60 days after planting		
Phosphorus rate	Phosphorus Source**					
P_2O_5Kg/ha	TSP	RP	Rate mean	TSP	RP	Rate mean
0	33.3 ab*	31.7 bc	32.5 a	33.7 a	34.7 a	34.2 b
50	32.7 abc	33.0 abc	32.8 a	33.3 a	34.7 a	36.0 ab
100	32.3 abc	33.7 ab	33.0 a	37.0 a	36.7 a	36.8 ab
150	31.7 bc	34.3 a	33.0 a	37.3 a	38.3 a	37.8 a
200	30.7 c	32.7 abc	31.7 a	37.7 a	33.7 a	35.2 ab
250	31.7 bc	32.7 abc	32.2 a	35.7 a	35.0 a	35.3 ab
Source mean	32.1 a	33.0 a		36.3 a	35.5 a	

* Means for each sampling date with at least one letter in common within colums and rows are not significanlty different at the 5% level according to DMRT.

** TSP = Triple superphosphate . R P = Rock phosphate .

plant interferred with Zn absorption unless addition of Zn was supplied or a high level of soil Zn existed .

Reduction of micro -element (Zn , Cu, Fe , Mn) utilization by plants on phosphated soils has been attributed to the immoblization of micro -elements in the soil by phosphorus precipitation (Racz and Halushak 1974) .

Warnock (1970) who reported that the phosphours - micro -element interactions were physiological in nature due to root surface absorption phenomena or reduced translocation within the plant.

5- SUMMARY AND CONCLUSION

Response of muskmelon to application rates (0, 50 , 100 , 150 , 200 and 250 kg P_2O_5 / ha) of rock phosphate and triple superphosphate were studied in Jordan valley at Deir Alla Agricultural Research Station and Jordan University Farm during the growing season of summer of 1989 .

Results of this Investigation are summarized as follows :

A. $NaHCO_3$ - extractable soil phosphorus

In both locations , rock phosphate application produced less impact on $NaHCO_3$ extractable soil phosphorus than did triple superphosphate . Phosphorus rates application significantly increased $NaHCO_3$-extractable soil phosphorus.However , triple superphosphate application at different rates increased the availabe soil phosphorus two times more than the available soil phosphorus produced by rock phosphate application at the same rate of P_2O_5 .

B. Yield

Application of rock phosphate and triple superphosphate at different rates had no significant effect on marketable , unmarketable , and total yield of muskmelon at the two locations . However , at University Farm location , higher phosphorus rates tended to reduce muskmelon yield .

C. Fruit number

In both locations , marketable , unmarketable and total fruit number were not significantly affected by phosphorus source and rates application .

D. Average fruit number per plant .

In both locations , phosphorus source had no significant effect on average fruit number per plant . However, at Deir Alla location, application of 100 and 200 kg P_2O_5 / ha regardless of phosphorus source , produced significantly higher average fruit number per plant , also application of 200 kg P_2O_5 / ha from rock phosphate significantly increased fruit number per plant at Deir Alla location .

E. Average fruit weight .

In University Farm location , phosphorus source and rates had no significant effects on average fruit weight , but triple superphosphate application significantly increased average fruit weight more than rock phosphate at Deir Alla location .

F. Vegetative growth .

Fresh and dry weight of vegetative parts were not significantly affected by phosphorus source and rates in both locations , but in University Farm location , higher rates application of phosphorus fertilizers significantly increased dry weight of muskmelon plants .

G. Total soluble soilds .

In both locations , phosphorus source had no significant effect on total soluble soilds per cent , but phosphorus rates application significantly increased total soluble soilds per cent of muskmelon fruit .

tended to increase the amount of $NaHCO_3$ - extractable soil phosphorus which means that rock phosphate could be a possible source of phosphorus , but further studies should be done on phosphatic fertilizers application especialy rock phosphate application in Jordan Valley soils .

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Appendix I

Table (1): Analysis of variance for $NaHCO_3$ - extractable soil phosphorus at two locations.

Source	df	Mean Square	
		University Farm	Deir Alla
Rep.	2	4.750	231.694
A	1	106.778	367.361
Error (A)	2	50.694	48.528
B	5	341.667*	331.961*
AB	5	10.844	18.494
Error (B)	20	4.089	7.278

* Significant at 5% level .

Table (2): Analysis of variance for total, marketable and Unmarketable muskmelon yield at University Farm location .

Source	df	Mean Square		
		Total yield (tons/ha)	Marketable yield (tons/ha)	Unmarketable yield (tons/ha)
Rep.	2	1.332	0.149	0.81
A	1	1.670	2.652	0.116
Error (A)	2	6.613	6.047	0.447
B	5	0.943	0.575	0.333
AB	5	1.073	1.028	0.437
Error (B)	20	4.585	2.979	0.798

Table (3): Analysis of variance for total, marketable and Unmarketable muskmelon yield at Deir Alla location .

Source	df	Mean Square		
		Total yield (tons/ha)	Marketable yield (tons/ha)	Unmarketable yield (tons/ha)
Rep.	2	4.203	5.260	0.126
A	1	0.243	0.010	0.179
Error (A)	2	0.835	0.822	0.066
B	5	0.522	0.572	0.012
AB	5	0.428	0.346	0.037
Error (B)	20	0.433	0.521	0.106

Table (4): Analysis of variance for Unmarketable , marketable and total muskmelon fruit number at University Farm location .

Source	df	Mean Square		
		Unmarketable fruit number /ha	Marketablefruit number/ha	Total fruit number/ ha
Rep.	2	1490128.948	323107.948	2666844.432
A	1	43392.402	1393687.081	1929113.017
Error (A)	2	361702.629	4518709.122	4663659.936
B	5	1374401.739	1011763.976	3583966.807
AB	5	726259.536	942328.303	1199868.389
Error (B)	20	1168976.576	3966052.171	5644321.954

Table (5): Analysis of variance for Unmarketable , marketable and total muskmelon fruit number at Deir Alla location .

Source	df	Mean Square		
		Unmarketable fruit number /ha	Marketablefruit number/ha	Total fruit number/ ha
Rep.	2	91639.198	564157.786	236328.041
A	1	583571.191	1393658.644	3780580.849
Error (A)	2	91632.504	1769847.776	1451477.668
B	5	85837.718	1571162.165	1431320.594
AB	5	178434.613	699261.074	482210.839
Error (B)	20	294173.108	837187.779	924966.069

Table (6): Analysis of variance for fresh weight per plant, dry weight per plant and Total soluble solids of muskmelon fruit at University Farm Location .

Source	df	Mean Square		
		Fresh weigh g/plant	Dry weight g/plant	TSS%
Rep.	2	3417.15	801.811	0.324
A	1	736.22	0.171	0.055
Error (A)	2	1181.02	33.906	0.221
B	5	1548.02	21.387*	0.335*
AB	5	884.74	9.180	0.052
Error (B)	20	11140.18	6.054	0.064

* Significant at 5% level .

Table (7): Analysis of variance for fresh weight per plant, dry weight per plant and Total soluble solids of muskmelon fruit at Deir Alla Location .

Source	df	Mean Square		
		Fresh weigh g/plant	Dry weight g/plant	TSS%
Rep.	2	625.875	1.215	0.319
A	1	95.388	83.144	0.047
Error (A)	2	310.135	51.168	0.112
B	5	132.515	7.838	0.378*
AB	5	72.805	4.268	0.016
Error (B)	20	95.416	8.873	0.043

* Significant at 5% level .

Table (8): Analysis of variance for P%, Cu, Fe Zn and Mn muskmelon leaves content at 30 days after planting at University Farm location .

Source	df	Mean Square				
		P%[1]	Cu (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Rep.	2	1.602	26.333	200.361	1.444	59.694
A	1	0.751	0.444	0.028	26.694*	235.111
Error (A)	2	0.119	16.778	806.861	0.444	89.194
B	5	0.138	1.000*	25.028	8.294*	48.378
AB	5	0.090	0.844	12.228	0.694	33.644
Error (B)	20	0.117	0.356	37.844	2.044	35.511

* Significant at 5% level .

(1) before statistical analysis values were multiplied by 10 .

Table (9): Analysis of variance for P%, Cu, Fe, Zn and Mn muskmelon leaves content at 30 days after planting at Deir Alla location .

Source	df	Mean Square				
		P%[(1)]	Cu (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Rep.	2	0.244	0.028	118.778	1.694	2.694
A	1	0.360	2.250	616.694	0.250	8.028
Error (A)	2	0.052	3.083	187.444	3.083	2.861
B	5	0.126*	0.761	497.361*	2.428*	1.694
AB	5	0.004	0.317	137.094	0.650	3.428
Error (B)	20	0.024	0.289	169.578	0.856	1.611

* Significant at 5% level .

(1) before statistical analysis values were multiplied by 10 .

Table (10): Analysis of variance for P%, Cu, Fe, Zn and Mn muskmelon leaves content at 60 days after planting at University Farm location .

Source	df	Mean Square				
		P%(1)	Cu (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Rep.	2	0.092	0.583	836.694	5.444	305.861
A	1	0.003	3.61	9.000	28.444	64.000
Error (A)	2	0.368	1.691	27.583	5.778	108.583
B	5	0.033	0.917	49.978	9.244*	101.511*
AB	5	0.085	0.694	51.733	4.711	37.000
Error (B)	20	0.103	0.63	55.439	1.778	34.922

* Significant at 5% level .

(1) before statistical analysis values were multiplied by 10 .

Table (11): Analysis of variance for P%, Cu, Fe Zn and Mn muskmelon leaves content at 60 days after planting at Deir Alla location .

Source	df	Mean Square				
		P%[(1)]	Cu (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Rep.	2	0.087	32.861	426.333	5.861	32.861
A	1	0.423	8.028	38.028	0.444	5.444
Error (A)	2	0.416	1.194	137.444	2.694	35.194
B	5	0.035	3.761*	249.050	1.844	10.178
AB	5	0.038	0.428	220.428	1.378	4.511
Error (B)	20	0.020	0.361	99.989	2.978	6.728

* Significant at 5% level .

(1) before statistical analysis were values multiplied by 10 .

Appendix II

Figure(1) The layout of University Farm experiment .

(S)

Rep. (1)		Rep.(2)		Rep.3
1 0 Kg P_2O_5 / ha		1 0 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha
6 250 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha		1 0 Kg P_2O_5 / ha
2 50 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha
3 100 Kg P_2O_5 / ha	TSP	6 250 Kg P_2O_5 / ha	RP	3 100 Kg P_2O_5 / ha
4 150 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha
5 200 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha
2 50 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha
3 100 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha
6 250 Kg P_2O_5 / ha	RP	2 50 Kg P_2O_5 / ha	TSP	6 250 Kg P_2O_5 / ha
1 0 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha
4 150 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha		1 0 Kg P_2O_5 / ha
5 200 Kg P_2O_5 / ha		1 0 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha

(N)

Figure(2) The layout of Deir Alla experiment.

(S)

6 250 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha
4 150 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha
3 100 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha
2 50 Kg P_2O_5 / ha	TSP	6 250 Kg P_2O_5 / ha	RP	1 0 Kg P_2O_5 / ha
5 200 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha
1 0 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha
1 0 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha
5 200 Kg P_2O_5 / ha		4 1 50 Kg P_2O_5 / ha		5 200 Kg P_2O_5 / ha
4 150 Kg P_2O_5 / ha	RP	5 200 Kg P_2O_5 / ha	TSP	1 0 Kg P_2O_5 / ha
2 50 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha		2 50 Kg P_2O_5 / ha
3 100 Kg P_2O_5 / ha		6 250 Kg P_2O_5 / ha		4 150 Kg P_2O_5 / ha
6 250 Kg P_2O_5 / ha		1 0 Kg P_2O_5 / ha		3 100 Kg P_2O_5 / ha
Rep. (1)		Rep.(2)		Rep.3

(N)