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Effect of Foliar and Soil Application of Plant Nutrients from Different Fertilizer Sources on Growth of Peach [Prunus persica (L.) Batsch] Saplings

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Abstract
A field experiment on growth of peach saplings as influenced by plant nutrients from different fertilizer sources and application methods, was conducted at Agriculture Research Institute, Mingora, Pakistan during 2014-15. The field was prepared before November and local peach seeds were sown with 2 ft row to row distance in 5 ft long rows. T-budding with "Springcrest" scion was done in June 2015. The experiment was laid out in RCBD split-plot arrangement with three replications. The main-plot treatments consisted of 1) control, 2) soil application of N-P (100 : 80 kg P_2O_5 : K_2O ha^{-1}), 3) foliar application of N-P-K (17-17-17 N-P_2O_5-K_2O @ 20 g L^{-1}), 4) foliar application of N-P-K-S (20-8-14-10 N-P_2O_5-K_2O-S @ 20 g L^{-1}), and 5) foliar application of urea (20 g urea L^{-1}), and sub-plot treatments were, 1) control, 2) soil application of urea fertilizer (120 kg N ha^{-1}), and 3) soil application of Ammonium Sulphate fertilizer (120 kg N ha^{-1}). Soil fertilizers were broadcasted on 3rd August 2015 and foliar were applied with small hand pump. The data were recorded from 4th August to 2nd December, 2015 at 15 days interval. Analysis of data revealed that the effect of fertilizer treatments on plant height and stem diameter of peach saplings was significant. Maximum plant height (151.67 cm) and stem diameter (15.98 mm) were gained by plants receiving fertilizer treatment of urea foliar (2%) and ammonium sulphate as a soil application. It was concluded from this study that fertilizer treatments of urea foliar (2%) and ammonium sulphate as a soil application increased plant height and stem diameter of peach saplings and hence are recommended for peach saplings of first year growth.
Keywords: foliar fertilizer, peach growth, peach nutrition, peach saplings, *Prunus persica*, foliar application

1. Introduction

Peach [*Prunus persica* (L.) Batsch] belongs to the family Rosaceae. It is native to China and at one time it was called 'Persian Apple'. Chinese literature dates its cultivation in China to 1000 BC. Probably it was then introduced to Persia (Iran), then the Peach quickly spread from there to Europe. In the 16th century, Peaches were established in Mexico, probably by Spaniards. In the 18th century Spanish missionaries introduced the Peach to California which turned out to be the most important production area after China and Italy (Crisosto and Valero, 2008).

Usually N is the only nutrient that is regularly supplied to peach trees on fertile soils, but as intensive production continues, deficiencies of various nutrients, i.e., K, Mg, Mn, B, Fe and Zn may arise. Deficiencies of P, Ca, S and Cu are rarely seen (Johnson, 1993). Conditions at Peshawar and Malakand division, especially Swat are best suited for Peach production. Peach orchard cover 15.2 thousands ha area in Pakistan producing 52.6 thousand tons of Peach fruit, while in Khyber Pakhtunkhwa it covers an area of 5.6 thousands hectares producing 30.8 thousand tons of Peaches (Agriculture Statistics of Pakistan, 2011). The soils of Swat valley are generally fertile. However, due to the adaptation of modern technology, per unit yield of fruit and other crops has increased. Therefore, plant nutrients are removed from soil at much faster rate than ever before and hence the soils are getting deficient both in major as well as micronutrients. A recent survey in Swat valley showed a wide spread deficiency of nutrients in fruit orchards (Shah and Shahzad, 2008).

The aim of the present investigation was to study the effect of plant nutrients from different fertilizer sources on growth of peach saplings.

2. Materials and Methods

2.1. Soil analysis before the experiment

Before the experiment triplicate soil samples were taken from 0-45 cm soil depth from the experimental site and analyzed at the laboratory of Soil Fertility Section of Agriculture Research Institute, Mingora, Swat. Soil texture was determined by using the method of Koehler et al., (1984). Organic matter content of the soil was determined by wet digestion method of Walkley and Black (Nelson and Sommers, 1982), Electrical conductivity was measured in 1:5 soil water suspension following 30 minutes of stirring and read on EC meter as reported by (Rhodes, 1996). Soil pH was measured in 1:5 soil water suspension following 30 minutes of stirring and read on pH meter (Mclean, 1982). AB-DTPA extractable P and K were determined by the procedure described by

(Soltanpour and Schwab, 1997)

Soil analysis of the experimental site indicate that the soil is slightly acidic, has low organic matter and is deficient in both P and K. Soil texture of the soil is silt loam. The details of the laboratory analyses are given in Table 1.

2.2. Field experiment

The experiment was conducted at Agricultural Research Institute Mingora, Swat, Pakistan. Before seed sowing, soil was properly prepared before the start of November 2014. The rootstock usually used for Peach Nursery rising in Khyber Pakhtunkhwa, Pakistan is Swat Local, so seeds from Peach Swat local variety were sown during the first week of November with row to row distance of 2 ft while the Row length was 5 ft. After six months when the seedlings had sufficiently grown until June 2015, T-budding was done with scion from variety "Springcrest", which is an early variety and has good market value. Fertilizers were applied to soil through broadcast method during 3rd August, 2015, while foliar fertilizers were applied through small hand pump during August 17, 2015. In the next year during January 2016, the Saplings became available for marketing.

The experiment was laid out in RCBD split plot arrangement with three replications. The main-plot treatments consisted of 1) control, 2) soil application of N-P (100 : 80 kg P_2O_5:K_2O ha^{-1}), 3) foliar application of N-P-K (17-17-17 N-P_2O_5-K_2O @ 20 g L^{-1}), 4) foliar application of N-P-K-S (20-8-14-10 N-P_2O_5-K_2O-S @ 20 g L^{-1}), and 5) foliar application of urea (20 g urea L^{-1}), while the sub-plot treatments consisted of, 1) control, 2) soil application of urea fertilizer (120 kg N ha^{-1}), and 3) soil application of Ammonium Sulphate fertilizer (120 kg N ha^{-1}). Soil fertilizers were applied on 3rd August 2015 through broadcasting and foliar application was done with the help of small hand pump.

The data were recorded from 4th August to 2nd December, 2015 at 15 days interval. Three plants from each treatment were randomly selected for data recorded and were averaged. Stem diameter was measured by Digital Vernier Caliper and plant height was measured from base to the tips of plant by Inch tape. The data were taken in the field with much caution, so that plants may not be damaged.

2.3. Statistical analysis

The collected data on peach saplings stem diameter and plant height were analyzed statistically using RCBD Split-plot with 3 replications using statistical Statistix 8.1. Treatments were compared using LSD test of significance according to Gomez and Gomez (1984).

3. Results

3.1. Plant height (cm)

The effect of different sources of fertilizer nutrients on plant height of peach saplings was statistically significant ($p<0.05$) (Table 2). The maximum plant height was gained by plants receiving fertilizer treatment of urea foliar (2%) and ammonium sulphate as a soil application (151.67 cm) followed by plants receiving fertilizer application of P_2O_5 + K_2O and ammonium sulphate (151.0 cm), while minimum plant height (85.0 cm) was gained by control (Figure 1).

3.2. Stem diameter (mm)

The effect of different sources of fertilizer nutrients on stem diameter of peach saplings was statistically significant ($p<0.05$) (Table 2 and Figure 2). The maximum stem diameter was gained by plants receiving fertilizer treatment of urea foliar (2%) and ammonium sulphate as a soil application (15.98 mm) followed by plants receiving fertilizer application of NPKS foliar (14.69 mm), while minimum stem diameter was gained by control (8.52 mm).

4. Discussion

Foliar application of urea supplied adequate nitrogen to the various tissues of peach plants including stem, braches and roots but N application through soil appears necessary for optimum vegetative growth as it is needed to support root growth as well. Johnson et al. (2001) reported similar results and found that 50%-50% combination treatment of soil-applied N in late summer with foliar-applied N in October, maintained yields and fruit Weight equal to the soil-fertilized control. Soil N application may be needed to support root proliferation and associated processes.

The results were supported by the work by Mirabdulbaghi and Zarghami (2013) who reported that the effect of increasing nitrogen fertilization as ammonium sulfate or urea on plant increases the stem diameter of peach seedlings. Plants take up nitrogen in the form of either nitrate or ammonium ions through the root hairs. Nitrogen is the basic element of plant proteins, including DNA and RNA and a primary component of chlorophyll and is therefore essential for photosynthesis. N also has a basic role in plant cell division and tissue differentiation. N is therefore essential in periods of rapid vegetative growth. Lack of N means that the plant will not utilize sunlight as an energy source to carry on essential functions such as nutrient uptake. N is very mobile in soil and moves with water to root surfaces for plant absorption.

Most agricultural crops require large quantities of nitrate-rich fertilizer to realize optimal yields (Oyinlola and Jinadu, 2012). The amount of N supplied by most soils in our conditions is small as compared to plant requirements. Most soil N comes from organic matter by releasing it slowly, being affected by factors such as moisture, soil pH and temperature. N from different fertilizer sources vary in their efficiencies and selection of good source may improve crop productivity. Method, dose and time of N application of fertilizers are vital for securing higher yields (Dong et al., 2005). Also, peach seedlings rootstocks have been reported to influence growth and yield of the scion cultivars (Layne et al., 1976).

5. Conclusions and Recommendations

The following conclusions were drawn from the finding of this study,

Fertilizer treatment of urea foliar (2%) and ammonium sulphate as a soil application increased plant height and stem diameter of peach saplings and hence are recommended for peach saplings until one year growth.

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TABLE 1: Soil analysis of experimental site before the experiment

Soil depth (cm)	**0-45**
Soil texture	Silt loam
$pH_{(1:5)}$	6.8
$EC_{(1:5)}$ (dS m^{-1})	0.98
Lime (g kg^{-1})	31.1
O.M (g kg^{-1})	8.68
ABDTPA Extractable P (mg kg^{-1} soil)	1.61
ABDTPA Extractable K (mg kg^{-1} soil)	59.71

Table 2: Effect of different sources of fertilizer nutrients and application methods on plant height and stem diameter of peach saplings

Treatment	**Nitrogen source**	**Plant height (cm)** [a]	**Stem diameter (mm)**
Control	Control	85.00 h [b]	8.52 h
	AS [g]	126.33 e	11.62 def
	Urea [h]	117.33 f	10.82 fg
NPKS foliar [c]	Control	133.33 cd	14.69 b
	AS	119.67 f	10.92 ef
	Urea	140.00 b	14.48 b
PK soil [d]	Control	134.33 bcd	12.65 cd
	AS	151.00 a	12.14 d
	Urea	111.33 g	9.77 g
Urea foliar [e]	Control	132.67 d	11.97 de
	AS	151.67 a	15.98 a
	Urea	138.67 bc	13.83 b
NPK foliar [f]	Control	126.00 e	10.87 efg
	AS	139.33 b	13.71 bc
	Urea	137.67 bcd	11.63 def
$LSD_{(0.05)}$		3.7616	0.9020

[a)]Data has been pooled from 3 replications and 3 randomly selected plants (total 9 values); [b)]Means followed by similar letter(s) in a column are statistically non-significant using least significant difference (LSD) test at 5% level of probability; [c)]Foliar application of N-P-K-S (20-8-14-10 N-P_2O_5-K_2O-S @ 20 g L^{-1}); [d)]Soil application of N-P (100 : 80 kg P_2O_5:K_2O ha^{-1}); [e)]Foliar application of urea (20 g urea L^{-1}); [f)]Foliar application of N-P-K (17-17-17 N-P_2O_5-K_2O @ 20 g L^{-1}); [g)] Soil application of Ammonium Sulphate fertilizer (120 kg N ha^{-1}); [h)] Soil application of Urea fertilizer (120 kg N ha^{-1}).

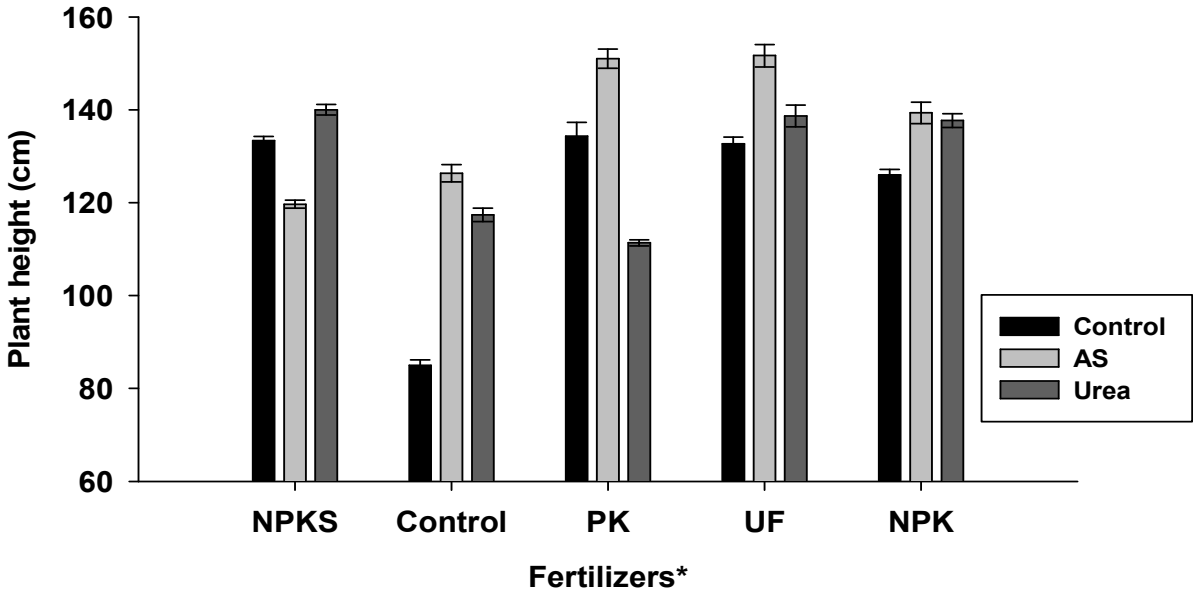

Figure 1 Effect of different sources of fertilizer nutrients and application methods on plant height of peach saplings.

*NPKS: Foliar application of 20-8-14-10 N-P_2O_5-K_2O-S @ 20 g L^{-1}; PK: Soil application of 100 : 80 kg P_2O_5:K_2O ha^{-1}; UF: Foliar application of urea (20 g urea L^{-1}); NPK: Foliar application of 17-17-17 N-P_2O_5-K_2O @ 20 g L^{-1}; AS: Soil application of Ammonium Sulphate fertilizer (120 kg N ha^{-1}); Urea: Soil application of Urea fertilizer (120 kg N ha^{-1}).

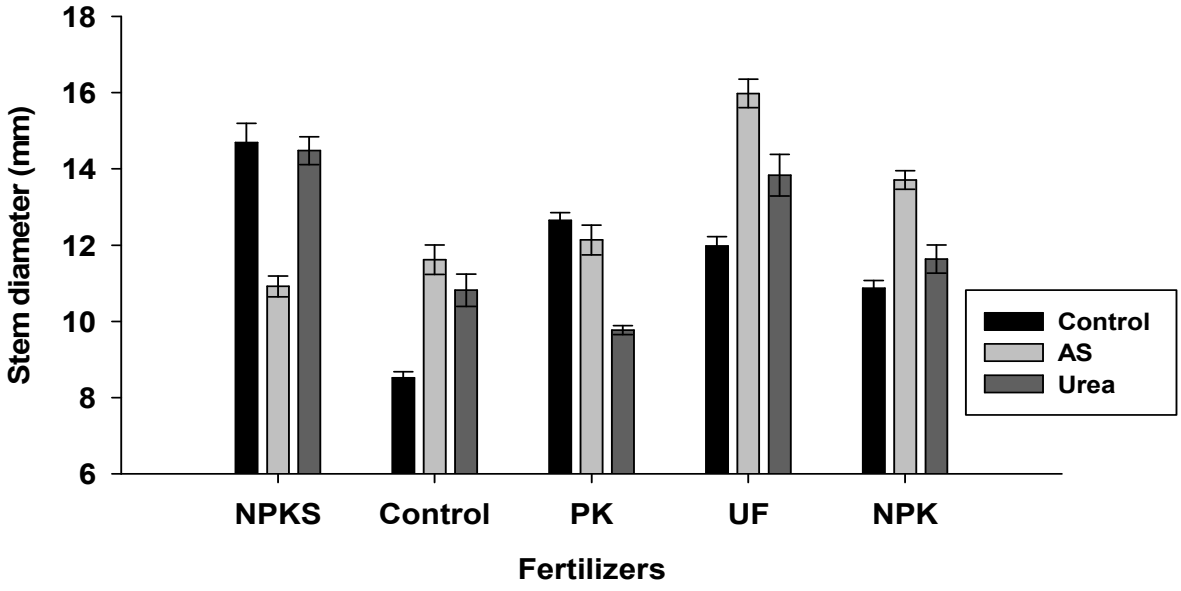

Figure 2 Effect of different sources of fertilizer nutrients and application methods on stem diameter of peach saplings.