

Effect of farmyard manure and mineral fertilization on growth and yield of early potato (*Solanum tuberosum*) under the Mediterranean conditions in Turkey

M. EMIN CALISKAN, S. KILIC, E. GUNEL AND M. MERT

Mustafa Kemal University, Faculty of Agriculture, Hatay, Turkey 31034

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ABSTRACT

A field experiment was conducted during the winter and spring months of 2000 and 2001 at Hatay, Turkey (36° 39' N, 36° 40' E), to study the effects of farmyard manure (0, 10, 20, 30, 40 and 50 tonnes/ha) and mineral fertilization (no or 200-90-90 kg/ha N-P-K respectively) on growth and yield of early potato (*Solanum tuberosum* L.) crop. Mineral fertilization significantly increased values of morphological traits and tuber yield, while it had negative effect on dry matter content of tuber. The application of farmyard manure also had positive effects on growth and yield with or without mineral fertilization. The farmyard manure also increased the efficiency of mineral fertilization. Tuber yield increased as the farmyard manure levels increased under non-mineral fertilized conditions while no significant increase obtained from 40 and 50 tonnes manure/ha rates in mineral-fertilized plots. Application of farmyard manure significantly increased the dry-matter content of tuber and this was more evident in mineral fertilized plots.

Key words : Mineral fertilization, Early potato, Nutrient management, Farmyard manure, Mediterranean region

The soils in the Mediterranean-type environments are characterized by low organic matter content in general. Consequently, growth and yield of potato crop are adversely affected in this region. Therefore, application of farmyard manure or green manure in potato production will improve both performance of potato and succeeding crops in rotation, in these regions. As potato responds best to farmyard manure, among all the field crops (Beukema and van der Zaag, 1990), the farmers have used it in potato production for a long time. Under different soil conditions, positive effects of farmyard manure application on growth and yield of potato crop were noticed, while the recommended amounts varied because of differences in soil conditions and manure types (Gunel and Karadogan, 1993; Kara and Nacitarhan, 1999; Singh, 2000). The potato crop responds also well to mineral fertilizers. Therefore integrated use of mineral fertilizers with farmyard manure could improve efficiency of nutrient management systems in potato (Sharma *et al.*, 1988). Besides, the application of farmyard manure improves organic matter content and structure of soil, the effectiveness of nitrogen given as a mineral fertilizer may be increase to some extent by applying farmyard manure (Beukema and van der Zaag, 1990; Gunel and Karadogan, 1993). With these views, this study was aimed to determine the effect of farmyard manure application with or without mineral fertilizers on growth

and yield of early potato crop in a mediterranean-type environment in Turkey.

MATERIALS AND METHODS

The experiment was carried out during 2000 and 2001 at the Experimental Farm of Mustafa Kemal University in Hatay, Turkey (36° N, 36° E). The soil had low organic matter content (0.54%) with clay structure and was slightly alkaline (pH 7.4). The available total nitrogen, available phosphorus and potassium contents were 0.066%, 103.9 kg/ha and 471 kg/ha respectively. The climate was typical Mediterranean, with mild and rainy winters, and hot and dry summers.

Twelve treatment combinations, comprising 2 mineral fertilizations (no or 200-90-90 kg/ha N-P-K respectively) and 6 doses of farmyard manure (0, 10, 20, 30, 40 and 50 tonnes/ha) were laid out in split-plot design with replications. The mineral fertilization levels were assigned to main plots and farmyard manure (FYM) levels to subplots. Each subplot comprised 4 rows, 10 m long and 70 cm apart. In mineral fertilization treatments, a part of N (90 kg/ha) and full dose of P₂O₅ (90 kg/ha) and K₂O (90 kg/ha) were applied at planting and remaining N (110 kg/ha) was side-dressed at time of tuber initiation. Decomposed cattle manure was used as farmyard manure and incorporated in soil in proper amount for each sub-plot be-

Table 1. Effect of FYM and mineral fertilization on plant height, stems/plant and tubers/plant of potato

FYM (tonnes/ha)	Plant height (cm)			Number of stems/plant			Number of tubers/ plant		
	NPK-	NPK+	Mean	NPK-	NPK+	Mean	NPK-	NPK+	Mean
0	22.4	29.1	258	2.8	3.3	3.1	4.8	6.5	5.6
10	24.1	30.0	27.0	2.9	2.9	2.9	5.2	7.1	6.1
20	23.9	30.2	27.1	2.5	3.0	2.8	5.4	7.5	6.5
30	4.0	31.6	27.8	26	3.1	2.9	5.9	7.6	6.8
40	23.8	32.7	28.2	2.7	3.2	3.0	6.0	8.5	7.3
50	26.1	31.0	28.5	2.9	2.9	2.9	6.0	8.1	7.1
Mean	24.0	30.8	27.4	2.8	3.0	2.9	4.8	6.5	5.6
CD (P=0.05)									
Mineral fertilization (M)		1.2			0.3			0.3	
FYM (F)		1.0			0.2			0.5	
M × F		1.4			0.3			0.6	

Table 2. Effects of farmyard manure and mineral fertilization on yield and dry matter of potato tuber

FYM (tonnes/ha)	Tuber yield (t/ha)			Dry-matter content (%)		
	NPK-	NPK+	Mean	NPK-	NPK+	Mean
0	13.80	23.28	18.54	19.8	17.8	18.8
10	14.81	24.78	19.79	19.2	17.9	18.5
20	16.71	26.85	21.78	19.2	18.7	18.9
30	16.13	27.27	21.70	19.8	18.8	19.3
40	16.31	30.36	23.34	19.6	18.9	19.2
50	17.63	30.49	24.106	19.4	19.3	19.3
Mean	15.90	27.17	21.54	19.5	18.6	19.0
CD (P=0.05)						
Mineral fertilizations (M)		1.10			0.4	
FYM (F)		1.56			0.6	
M×F		6.21			2.7	

fore planting. The medium-early potato cultivar 'Marfona' was planted with 25 cm intra-row spacing using an assist-feed planter on 9 March in 2000 and 18 January in 2001. Furrow irrigation was applied 3 times in 2000 and 4 times in 2001. Plants were harvested with a one-row harvester on 5 June in 2000 and 23 May in 2001. Growth and yield attributes were determined on 10 randomly selected plants in each subplot, prior to harvest. Total tuber yield/ha was calculated using tuber weight of 2 centre rows. Tuber samples were cut into small pieces, and dried in an oven at 70°C until constant weight for dry-matter determination.

RESULTS AND DISCUSSION

Mineral fertilization, farmyard manure (FYM) doses and mineral fertilization × FYM dose interaction significantly affected plant height (Table 1). Plant height increased with increasing FYM doses and mineral fertilization, while the plants of more height were obtained with mineral fertilization at each FYM level. The highest plant height (32.7 cm) was obtained with integrated use of 40 tonnes/ha FYM and mineral fertilizers (Table 1). The number of stems/plant was slightly increased with mineral fertilizers, while no significant effect attributable to FYM

in respect to this trait was noticed. Although the effects of mineral fertilization by FYM interaction were also significant on number of stems/plant, no consistent change was observed among treatments (Table 1).

Both the mineral fertilization and FYM application significantly affected tubers/plant and mean tuber weight, whereas no significant effect of mineral fertilization × FYM interaction on both traits were found (Table 1). The integrated use of mineral fertilizers and FYM was more efficient on tubers/plant. The highest number of tubers/plant (8.5) was obtained with integrated application of 40 tonnes/ha FYM with mineral fertilizers, while the lowest number of tubers (4.8) was obtained from unfertilized plot (Table 1). Gunel and Karadogan (1993) and Kara and Nacitarhan (1999) also reported similar findings. Mean tuber weight increased with FYM levels in mineral fertilized plots and reached maximum of 87.8 g at 50 tonnes/ha, while no further significant increase in mean tuber beyond 20 tonnes/ha FYM was noted in non-mineral fertilized plots (Table 1).

The mineral fertilization, FYM application and mineral fertilization × FYM interaction significantly affected the tuber yield and tuber dry-matter content (Table 2). Appli-

cation of mineral fertilizers resulted in higher tuber yield, i.e. over 11 tonnes/ha, on an average. Application of FYM had also positive effect on tuber yield. Results relating to tuber yield clearly indicated that application of FYM at any level without mineral fertilization did not supply enough nutrients for potato crop. However, FYM applications increased the efficiency of mineral fertilization. The maximum increase in mean tuber yield owing to FYM application was 3.83 tonnes/ha in non-mineral fertilized plots and 7.21 tonnes/ha in mineral-fertilized plots. The integrated use of mineral fertilizers with 40 or 50 tonnes FYM/ha resulted in the highest tuber yields. These results could be attributed to more nutrient supply as well as improvement in efficiency of mineral nutrients due to the integrated use of FYM and mineral fertilizers as suggested by Beukema and van der Zaag (1990) and Sharma *et al.* (1988).

Dry matter of tuber was negatively affected by mineral fertilization (Table 2). However, application of FYM significantly increased the dry matter of tuber and this was

more evident in mineral-fertilized plots.

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