# Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 5 (2): 300-303, 2006
ISSN 1682-3974
© 2006 Asian Network for Scientific Information

# Effect of Different Soil Tillage, Weed Control and Phosphorus Fertilization on Weed Biomas, Protein and Phosphorus Content of Chickpea (*Cicer arietinum* L.)

[1]Nihal Kayan and [2]M. Sait Adak
[1]Department of Field Crops, Faculty of Agriculture, Osmangazi University, 26480 Eskişehir, Turkey
[2]Department of Field Crops, Faculty of Agriculture, Ankara University, 06110 Ankara, Turkey

**Abstract:** This research was carried out in Central Anatolian Region (Haymana, Turkey) throughout 2 years (2002 and 2003). The objective of this study was to determine the effects of different soil tillage methods, weed control and phosphorus fertilizer doses on yield and yield componenets of chickpea. The experimental design was split split plot with three replications. In the research, two different soil tillage methods (moldboard plow and rotary tiller), two weed control methods ( hand weeding and herbicide application) and three phosphorus doses (30, 60 and 90 kg $P_2O_5$ ha) were used. According to the results, different soil tillage methods and phosphorus fertilization did not have any effect on yield components. In addition to it, increasing levels of phosphorus had decreased the grains phosphorus content. Weed control methods had effect on dry weed biomass and grain yield. If weed control, by hand is not possible, herbicide application may advice as an alternative solution.

**Key words:** Chickpea, soil tillage, weed control, phosphorus fertilization

## INTRODUCTION

Chickpea is grown at different ecological area of the world. It can be grown salty, limy and poor areas. In Turkey, total growing area of this crop is 650,000 ha with a total production of 590,000 tons (Anonymous, 2002).

One of the limiting factor of high yield in chickpea is the weeds like other legumes. Chickpea is grown in arid and semiarid area where soil humudity is limited and plants have to compote with weeds for it. According to Bhan and Kukula (1987), grain yields may decrease up to 40-90% related to weed density. Weed control can be made by different method but hand weeding is the most effective way. Because of hand weeding is not possible wide area, cultural methods and herbicidal control can be use as alternatives. Soil tillage is an important cultural method. Usually lime level has exceed 25% in dry areas of Central Anatolia (Eyüpoğlu, 1997). Therefore, phosphorus fertilization is important for this area because chickpea is grown at marginal areas. Phosphorus fertilization is not a widely use practice in Turkey.

The objective of this study was to determine the effects of different soil tillage methods (tradational tillage (TT)-minimum tillage (MT), weed control (hand weeding and herbicid application) and phosphorus fertilizer doses (30, 60 and 90 kg $P_2O_5$ ha) on some quality features, yield and yield components of chickpea.

## MATERIALS AND METHODS

This research was conducted for two years period in the experimental field of Research and Application Farm, Faculty of Agriculture, University of Ankara (Haymana) in 2002 and 2003. Characteristics of the soil at experimental site are presented in Table 1. Climatic data related to the research location are shown in Table 2.

The variety Gökçe was used as research material. Gökçe was sown on March 18 in first year and April 16 in second year due to climatic conditions.

**Soil tillage methods:** Traditional Tillage (TT): moldboard plow (15-20 cm depth). Minimum Tillage (MT): Rotary tiller (8-10 cm depth).

Table 1: Soil characteristic of the experimental site

| | 2002 | 2003 |
|---|---|---|
| Organic mater (%) | 2.10 | 1.58 |
| Clay (%) | 37.8 | 26.0 |
| Sand (%) | 20.0 | 26.0 |
| Silt (%) | 42.0 | 48.0 |
| pH | 7.14 | 7.8 |
| E. conduct (mmhos $cm^{-1}$) | 0.231 | 0.296 |
| N (%) | 0.14 | 0.18 |
| $P_2O_5$ (ppm) | 8.14 | 31.76 |
| $K_2O$ (ppm) | 249 | 332 |

**Corresponding Authoer:** Nihal Kayan Department of Field Crops, Faculty of Agriculture, Osmangazi University, 26480 Eskişehir, Turkey Tel: 90-222-3242991/16

**Weed control methods:**
**Hand weeding:** Repeated two times (in 1/3 of subplots).
**Herbicidal weed control:** The treatment consisted 1250 cc aclonifen $ha^{-1}$ post emergence during 2-3 leaves stage of weeds the herbicide was applied in 300 L water $ha^{-1}$ (in 1/3 of subplot).

**Phosphorus fertilization:** 30, 60 and 90 kg $P_2O_5$ $ha^{-1}$ (as Triple Super Phosphate) were applied at sowing time with sowing machine.

The experimental design was split split plot with three replications. Experiment was conducted as tillage systems main plots, weed control methods sub-plots and phosphorus fertilizations sub-subplots. Each sub- subplots was 12.5 $m^{-2}$ in size. Chickpea seeds were sown by sowing machine with 30 cm row spacing in 5 cm depth. Nitrogen fertilization was sowing time (20 kg $ha^{-1}$).

Weed biomass and biological yields (g $m^{-2}$) were determined at each sub-subplot in the 0.25 $m^{-2}$ area. Afterwards each sub-subplot was harvested, blended and grain yield (g $m^{-2}$) was estimated. Grain protein content (%) was determined by microkjeldahl method (Kjeldahl 1883, Bremner 1960). The grain and the plant phosphorus content were determined by vanadomolibdo phosphoric acid method (Kitson and Mellon, 1944).

The data were statistically analysed to determine the significance of the treatments with MINITAB. Duncan test was used on all the measured parameters.

## RESULTS

Significant differences were observed for weed control methods and "weed control method × soil tillage system" interaction for dry weed biomass ($p<0.01$), meanwhile weed control methods were significant for grain yield in the first year. Phosphorus fertilization methods were also shown differences for grain phosphorus content (Table 3). In the second year, differences were observed for weed control methods for dry weed biomass and "weed control method × soil tillage systems" interaction for grain phosphorus content (Table 4).

Weed control methods were shown significant differences for dry weed biomass first and second year.

Avarege value are belong to characteristics that. In the first year, dry weed biomass was effacted by weed control method x soil tillage systems interaction. Weedy check value was higher than herbicidal weed control value in the TT area but dry weed biomass value was same with weedy check and herbicidal weed control MT area. Dry weed biomass value at TT was higher than at MT in weedy check plots but TT value was lower than MT value in herbicidal weed control plots. Dry weed biomass values were zero in the hand weeding areas (Table 3). In the second year, dry weed biomass value was 159.70 g $m^{-2}$ in weedy check plots and 39.20 g $m^{-2}$ in herbicidal weed control plots. Dry weed biomass values were also zero in the hand weeding areas (Table 4).

In the first year highest grain yield was obtained in hand weeding plots. This value is followed by herbicidal weed control and the lowest value is observed in the weedy check plots. Hand weeding treatment values were in different groups.

The lowest value for the grain phosphorus content (0.29%) were observed in 90 kg $P_2O_5$ $ha^{-1}$ treatment plots in the first year. The grain phosphorus content value was same as 30 and 60 kg $P_2O_5$ $ha^{-1}$ (0.31%) (Table 3). In the second year, the grain phosphorus content was effacted by "weed control method × soil tillage systems" interaction. The grain phosphorus content wasn't effacted by weed control methods in MT plots.

In TT plots, the lowest and highest grain phosphorus content value was determined at herbicidal weed control plots and weedy check plots respectively. In weedy check plots, the grain phosphorus content was observed as 0.35% and 0.32% at TT and MT plots, respectively (Table 4).

## DISCUSSION

Significant differences were observed for weed control methods for dry weed biomass in both years. In both years, dry weed biomass value was 0.00 in hand weeding plot. Herbicidal weed control plots value was lower than weedy check plots for dry weed biomass. According to these results herbicidal weed control may advice as a solution. Unger (1999), Begna *et al.* (2001) and Torresen *et al.* (1999), was reported similar results. "Soil tillage × weed control methods" interaction was significant in the first year. In the first year, dry weed biomass was observed as 210.40 and 64.20 g $m^{-2}$ at weedy check plots and hand weeding plots respectively in TT plots. However in MT plots, dry weed biomass was 101.30 g $m^{-1}$ at weedy check and herbicidal weed control plots. Owing to weed diversity, herbicidal weed control wasn't showed expected influence in MT plots. So in contrast to our expectation in weedy check plots, dry weed biomass was higher (210.40 g $m^{-2}$) in TT plots than in MT plots (101.30 g $m^{-2}$).

Differences between weed control methods were significant for grain yield in first year. The highest value was observed in hand weeding plots, herbicidal weed control plots value was followed it and the lowest value was observed in weedy check plots (Table 3). Present results are in agreement with the finding of Anaele and Bishnoi (1992). Grain yield wasn't influenced by different soil tillage methods. This results are similar to Adak (1999) and Hernanz's (2002), results. Different phosphorus

Table 2: Climatic data of the research location

| Years | Months | Temperature (°C) | Rainfall (mm) | Relative humidity (%) | Years | Months | Temperature (°C) | Rainfall (mm) | Relative humidity (%) |
|---|---|---|---|---|---|---|---|---|---|
| 2002 | March | 6.5 | 47.0 | 77.8 | 2003 | | | | |
| | April | 8.3 | 82.2 | 81.9 | | April | 8.2 | 73.7 | 76.8 |
| | May | 13.8 | 25.8 | 70.6 | | May | 16.4 | 60 | 68.5 |
| | June | 18.3 | 7.0 | 67.8 | | June | 19.9 | 0.0 | 63.8 |
| | July | 22.6 | 66.7 | 64.4 | | July | 21.3 | 5.5 | 60.8 |
| Total | | | 228.7 | | | | | 139.2 | |
| Mean | | 13.9 | | 72.5 | | | 16.4 | | 67.47 |

Table 3: Effect of tillage, weed control and phosphorus fertilization on some traits of chickpea (*Cicer arietinum* L.) in 2002

| Soil tillage systems | Weed control methods | Phosphorus time fertilization | Flowering (sowing-flowering day) | Dry weed biomass (g m$^{-2}$) | Biological yield (g m$^{-2}$) | Grain yield (g m$^{-2}$) | The grain protein content (%) | The grain phos content (%) | The plant phos content (%) |
|---|---|---|---|---|---|---|---|---|---|
| TT | Weed check | | 73.78 | 210.40 *A* 1 | 404.90 | 107.78 | 21.95 | 0.34 | 0.08 |
| TT | Hand weeding | | 74.67 | 0.00 *C* 1 | 448.90 | 162.88 | 20.61 | 0.29 | 0.05 |
| TT | Herbicide | | 72.67 | 64.20 *B* 1 | 384.00 | 148.51 | 21.03 | 0.31 | 0.05 |
| MT | Weed check | | 74.44 | 101.30 *A* 2 | 378.70 | 130.30 | 20.21 | 0.29 | 0.05 |
| MT | Hand weeding | | 72.78 | 0.00 *B* 1 | 521.80 | 148.77 | 20.80 | 0.28 | 0.06 |
| MT | Herbicide | | 73.56 | 101.30 *A* 1 | 392.40 | 101.00 | 21.13 | 0.32 | 0.08 |
| Mean (TT) | | | 73.70 | 91.60 | 412.60 | 139.72 | 21.2 | 0.31 | 0.06 |
| Mean (MT) | | | 73.59 | 67.60 | 431.00 | 126.68 | 20.73 | 0.29 | 0.06 |
| | Mean (Weed check) | | 74.11 | 155.90 | 391.80 | 119.02 b | 21.13 | 0.32 | 0.07 |
| | Mean (Hand weeding) | | 73.72 | 0.00 | 485.30 | 155.82 a | 20.70 | 0.28 | 0.05 |
| | Mean (Herbicide) | | 73.11 | 82.80 | 388.20 | 124.76 b | 21.08 | 0.31 | 0.06 |
| | | Mean (30 kg $P_2O_5$/ha) | 73.78 | 78.20 | 439.10 | 128.46 | 20.91 | 0.31 a | 0.06 |
| | | Mean (60 kg $P_2O_5$/ha) | 74.11 | 72.90 | 416.20 | 136.95 | 21.87 | 0.31 ab | 0.06 |
| | | Mean (90 kg $P_2O_5$/ha) | 73.06 | 87.60 | 410.00 | 134.19 | 20.17 | 0.29 b | 0.05 |
| Soil tillage (A) | | | NS | NS | NS | NS | NS | NS | NS |
| Weed control (B) | | | NS | 109496** | NS | 7058.7* | NS | NS | NS |
| A × B | | | NS | 25.998** | NS | NS | NS | NS | NS |
| Phosphorus fertilization (C) | | | NS | NS | NS | NS | NS | 0.0023* | NS |
| A × C | | | NS | NS | NS | NS | NS | NS | NS |
| B × C | | | NS | NS | NS | NS | NS | NS | NS |
| A × B × C | | | NS | NS | NS | NS | NS | NS | NS |

*: Significant at the 0.05 probability level, Italic letters are used that as the different soil tillage systems are comparisoned weed control methods means
**: Significant at the 0.01 probability level, Figures are used that as the different weed control methods are comparisoned soil tillage systems means

fertilization was positively influenced the grain yield but differences wasn't significant.

In second year, biological yield and grain yield values are higher than first year because of effective rainfall. In first year, effective rainfall was 108 mm (April + May) but in second year this value was 133.70 mm (Table 2).

Significant differences were observed among phosphorus fertilization in first year and soil tillage×weed control methods interaction in second year for the grain phosphorus content. In 30 and 60 kg $P_2O_5$ ha$^{-1}$ treatment plots, the grain phosphorus content was %0.31. In 90 kg $P_2O_5$ ha$^{-1}$ treatment plots, this value was 0.29%. Generally the grain phosphorus content was decreased in the first year by phosphorus fertilization. We expect that the grain phosphorus content is increased by phosphorus fertilization. We may explain this situation with plant density in plot. While grain yield was increasing, the grain phosphorus content was decreasing. Idris *et al.* (1989) reported that the grain phosphorus content was decreased by phosphorus fertilization. This results are similar to our results. Soil tillage and weed control methods interaction was significant in second year for the grain phosphorus content. The grain phosphorus content wasn't effected by weed control methods in TT plots and MT plots. The grain phosphorus content was observed as 0.35 and 0.32% in TT plots and MT plots respectively in weedy check plots.

In second year, the grain phosphorus content values were higher than first year. In the first year, soil phosphorus content was 8.4 ppm but in second year this value was increased to 31.76 ppm (Table 1). The grain phosphorus content values was higher in second year because of soil phosphorus contain. In second year, effective rainfall might be increased physiological activity so the grain phosphorus content was higher.

Results of this research indicated that dry weed biomass was influenced by weed control methods in both year. Weedy check plots values was higher than herbicidal weed control plots for dry weed biomass. Hand weeding method is the most effective method in weed control. When hand weeding isn't possible in wide areas, herbicide application can be effective alternative for control. We were observed similar results for grain yield.

Table 4: Effect of tillage, weed control and phosphorus fertilization on some traits of chickpea (*Cicer arietinum* L.) in 2003

| Soil tillage systems | Weed control methods | Phosphorus fertilization | Flowering time (sowing-flowering day) | Dry weed biomass (g $m^{-2}$) | Biological yield (g $m^{-2}$) | Grain yield (g $m^{-2}$) | The grain protein content (%) | The grain phos. content (%) | The plant phos. content (%) |
|---|---|---|---|---|---|---|---|---|---|
| TT | Weed check | | 57.78 | 125.6 | 615.6 | 231.9 | 24.84 | 0.35 *A* 1 | 0.04 |
| TT | Hand weeding | | 56.89 | 0 | 617.8 | 247.91 | 24.69 | 0.33 *AB* 1 | 0.04 |
| TT | Herbicide | | 56.78 | 14.44 | 583.6 | 238.55 | 25.15 | 0.32 *B* 1 | 0.03 |
| MT | Weed check | | 57.33 | 193.8 | 400 | 132.34 | 23.12 | 0.32 *A* 2 | 0.03 |
| MT | Hand weeding | | 57.67 | 0 | 584.4 | 204.7 | 22.95 | 0.31 *A* 1 | 0.03 |
| MT | Herbicide | | 57.89 | 64 | 540 | 176.5 | 23.52 | 0.33 *A* 1 | 0.04 |
| Mean (TT) | | | 56.81 | 46.7 | 605.6 | 239.44 | 24.89 | 0.33 | 0.04 |
| Mean (MT) | | | 57.63 | 85.9 | 508.1 | 171.18 | 23.2 | 0.32 | 0.03 |
| | Mean (Weed check) | | 57.06 | 159.70 a | 507.8 | 182.1 | 23.98 | 0.34 | 0.04 |
| | Mean (Hand weeding) | | 57.28 | 0.00 c | 601.1 | 226.31 | 23.82 | 0.32 | 0.04 |
| | Mean (Herbicide) | | 57.33 | 39.20 b | 561.8 | 207.5 | 24.33 | 0.32 | 0.03 |
| | | Mean (30 kg $P_2O_5$/ha) | 57.39 | 61.2 | 547.8 | 202.2 | 23.74 | 0.33 | 0.04 |
| | | Mean (60 kg $P_2O_5$/ha) | 57.17 | 79.1 | 566.7 | 209.9 | 24.45 | 0.33 | 0.03 |
| | | Mean (90 kg $P_2O_5$/ha) | 57.11 | 58.6 | 556.2 | 203.8 | 23.95 | 0.32 | 0.04 |
| Soil tillage (A) | | | NS | NS | NS | NS | NS | NS | NS |
| Weed control (B) | | | NS | 124616* | NS | NS | NS | NS | NS |
| A × B | | | NS | NS | NS | NS | NS | 0.0028* | NS |
| Phosphorus fertilization (C) | | | NS | NS | NS | NS | NS | NS | NS |
| A × C | | | NS | NS | NS | NS | NS | NS | NS |
| B × C | | | NS | NS | NS | NS | NS | NS | NS |
| A × B × C | | | NS | NS | NS | NS | NS | NS | NS |

*: Significant at the 0.05 probability level, İtalic letters are used that as the different soil tillage systems are comparisoned weed control methods means. Figures are used that as the different weed control methods are comparisoned soil tillage systems means

Herbicidal weed control was effective on grain yield. But hand weeding was the most effective methods for grain yield. The phosphorus fertilization didn't have any significant effect on yield components. In first year, the grain phosphorus content was decreased by phosphorus fertilization. We may explain this situation with plant density. Soil tillage methods wasn't effective on yield components in first and second year.

## REFERENCES

Adak, M.S., 1999. Orta Anadolu bölgesi'nde alişilagelmiş ve azaltilmiþ toprak işleme yöntemleri ile nadasli ve nadassiz yetiştirilen buğdayin bazi verim ögelerinin belirlenmesi. Tarla Bitkileri Merkez Araştirma Enstitüsü Dergisi, 8: 93-99.

Anaele, A.O. and U.R. Bishnoi, 1992. Effects of tillage, weed ontrolmethodand row spacing on soybean yield and certain soil proporties. Soil and Tillage Res., 23: 333-340.

Anonymous, 2002. http://apps.fao.org/page/collections?Subset: Agriculture, 12: 12.2003.

Begna, S.H., R.I., Hamilton, L.M., Dwyer, D.W., Stewart, D., Cloutier, A., Liu and D.L. Smith, 2001. Response of corn hybrids differing in canopy architecture to chemical and mechanical (rotary hoeing) weed control: Morphology and yield. J. Agron. Crop Sci., 186: 167-173.

Bhan, V.M. and S. Kukula, 1987. Weeds and their Control in Chickpea. The Chickpea (Ed., Saxena and Singh), pp: 319-328 ICARDA.

Bremner, J.M., 1960. Determination of nitrogen in soil by Kjeldahl metod. J. Agric. Sci., 55: 1-23.

Eyüpoğlu, H., 1997. Kireç kapsami farkli topraklarda fosforun nohutta verim ve bazi kalite özelliklerine etkisi. Doktora tezi (basilmamiş). Ankara Üniversitesi, Ankara.

Hernanz, J.L., R., Lopez, L., Navarrete and V. Sanchez-Giron, 2002. Long-term effects of tillage systems and rotations on soil structural stability and organic carbon stratification in semiarid central Spain. Soil and Tillage Res., 66: 129-141.

Idris, M., T. Mahmood and K.A. Malik, 1989. Response of field-grown chickpea (*Cicer arietinum* L.) to phosphorus fertilization for yield and nitrogen fixation. Plant Soil, 114: 135-138.

Kitson, R.E. and M.G. Mellon, 1944. Colorimetric determination of phosphorus as molybdovancidophosphoric acid. Ind. Eng. Chem. Anal. Ed. IG, pp: 379-383.

Kjeldahl, J., 1883. Neve methode zur Bestimmong des sticksstoffs in organischen körpern. Z. Anal. Chem., 22: 360-382.

Torresen, K.S., R. Skuterud, L. Weiseth, H.J. and Tandsaether, S.H. Jonsen, 1999. Plant protection in spring cereal production with reduced tillage. I. Grain yield and weed development. Crop Prot., 18: 595-603.

Unger, P.W., S.D., Miller and O.R. Jones, 1999. Weed seeds in long-term dryland tillage and cropping system plots. Weed Res., 39: 213-223.