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Intercropping with Eggplant for Proper Utilisation of Interspace under Greenhouse Conditions

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Summary

This study was carried out to determine the potential and response of eggplant to intercropping with bean, cos lettuce and leaf lettuce under greenhouse conditions in 2000 and 2001. The study has shown that early and total yield of eggplant were not affected by intercropping compared to sole cropping. However, intercropping increased significantly the net income compared to sole cropping. The highest net income was obtained by the eggplant+cos lettuce intercropping system, whereas the lowest was obtained by eggplant sole cropping. Land equivalent ratios (LER) were always greater than 1 in intercropping systems. In both years, the intercropping system of eggplant+leaf lettuce gave the highest LER value as 1.21 and 1.18, respectively.

Zusammenfassung

Unterkultur bei Auberginen zur optimalen Zwischenraumnutzung unter Gewächshausbedingungen. Diese Untersuchungen wurden in den Jahren 2000 und 2001 durchgeführt, um bei Auberginen unter Gewächshausbedingungen die Möglichkeiten und Reaktionen einer Unterkultur mit Buschbohnen, Römischem Salat und Pflücksalat zu ermitteln. Dabei zeigte sich, dass die Zwischenpflanzung im Vergleich zur alleinigen Auberginenkultur keinen Einfluss auf den frühen Erntebeginn und die Erntemenge hat. Allerdings erhöhte die Zwischenkultur das Nettoeinkommen erheblich. Das höchste Nettoeinkommen konnte mit der Kombination Auberginen und Römischem Salat, das geringste mit der alleinigen Auberginenkultur erzielt werden. Die Flächenäqivalentwerte (LER) lagen bei allen Zwischenkulturkombinationen über 1. In beiden Versuchsjahren erbrachte die Kombination Auberginen und Pflücksalat den höchsten LER-Wert mit 1.21 bzw. 1.18.

Key words. eggplant – bean – lettuce – growth – intercropping – yield – *Solanum melongena*

Introduction

Intercropping has been considered advantageous in terms of economy of space, saving on tillage, as well as utilisation of available nutrients and moisture in unused space. It could result in an increase in the productivity of vegetables per unit area, and could improve gross returns (VARGHESE 2000). Researches have also shown that intercropping has a great potential for pest, disease and weed reduction (BAUMANN et al. 2000). To maintain yield and quality in intercropping systems, complementarities in patterns of resource use must be taken into account. Cultivars suitable for intercropping should enhance the complementary effects among species.

According to a rating system considering total yield per unit area, price per unit weight harvested and the time required between seedling and harvest, eggplant is not a space-efficient crop and usually may not return a higher monetary value for the space they occupy than other vegetables (SPLITTSTOESSER 1990). Eggplant is a relatively long-term crop and long-term crops in first growth stage may slowly grow and first establish full canopy after several weeks, opening an opportunity for a short-cycle crop to be grown between rows (FUKAI and TRENBATH 1993). Solar radiation, water, and some nutrients would be wasted during early growth stages of long-term crops, but they can be utilised by an associated crop growing between the rows (MIDMORE 1993). Many studies have indicated that intercropping with different vegetables was more productive and profitable than sole cropping, because of the complementary effects of intercrops (VARGHESE 2000). However, for eggplant, the information about improving production through suitable intercrop combinations is very limited under greenhouse conditions.

Materials and Methods

This study was conducted at Ataturk University, Hamza Polat Vocational School, Turkey, under unheated greenhouse conditions in 2000 and 2001. The experimental area soil was of sandy loam with pH 7.10 and 6.80; organic matter 1.75 and 2.28 %; available P_2O_5 17 and 31 kg ha^{-1}; K_2O 2100 and 3650 kg ha^{-1} in 2000 and 2001, respectively. A basal dose of 100 kg N ha^{-1} as ammonium nitrate and 100 kg ha^{-1} P_2O_5 as triple super phosphate were broadcasted uniformly on the soil surface and incorporated before planting (HOCHMUTH et al. 1991; GUNAY 1993).

Eggplant (*Solanum melongena* L. var. *esculentum* Nees cv. 'Faselis' F_1) was used as main crop, and bean (*Phaseolus vulgaris* L. var. *nanus* cv. 'Gina'), cos lettuce (*Lactuca sativa* L. var. *longifolia* cv. 'Yedikule') and leaf lettuce (*Lactuca sativa* L. var. *crispa* cv. 'Iri Kývýrcýk') were used as intercrops. It was employed a randomised complete block design as the experimental design with each treatment replicated 3 times. Treatments consisted of eggplant alone, eggplant+bean, eggplant+cos lettuce, eggplant+leaf lettuce, and cos lettuce alone, leaf lettuce alone and bean alone. Each plot size was 3.0x2.0 m. Eggplant spacing was 1.0x0.5 m in both sole cropping (GUNAY 1993) and intercropping. In intercropping treatments, one row bean (within-row plant spacing 20 cm), cos lettuce and leaf lettuce (within-row plant spacing 30 cm) were planted in the middle of the eggplant rows.

Seeds of eggplant were sown in 15x15 cm plastic bags filled with peat (pH: 5.5–6.0, EC: 250 mmhos cm^{-1}, N: 50–300 mg l^{-1}, P_2O_5: 80–300 mg l^{-1}, K_2O: 80–400 mg l^{-1}, organic matter: 2 %). Eggplant (about 1.5 month old), cos lettuce, and leaf lettuce seedlings (about 1 month old) were transplanted, and bean was sown simultaneously on May 15 in 2000 and May 18 in 2001.

During the growing period, drip irrigation was used. Insecticide and fungicide were applied to avoid crop damage by mole chicket, aphids, and diseases. Weeds were kept under control by hand.

Eggplant was harvested between 08 July and 25 September in 2000, 10 July and 21 September in 2001. Cos lettuce was harvested in 28 June in 2000 and 02 July in 2001. Leaf lettuce was harvested in 10 June in 2000 and 12 June in 2001. The harvest period of bean was between 20 June and 18 August in 2000, 19 June and 20 August in 2001.

Fruit weight, fruit number per plant, early yield (1 month-period from first harvest), and total yield of eggplant were determined. The productivity of the intercropping was evaluated by the land equivalent ratio (LER) and economic net income.

$$LER=LA+LB=AI/AS+BI/BS,$$

where LA and LB are the individual LERs of two crops A and B, LA is obtained by dividing the yield of crop A in intercropping (AI) by the yield of the same crop in sole cropping (AS). LB is calculated in the same way (VANDERMEER 1989).

Economic net income analysis was undertaken to assess economic feasibility of different intercrops. Cost of land, buildings and equipment were not included, as they were assumed to be the same for all systems. Material included all cash expense items of fertilizer, seeds, plant trays, crates, etc. Labour included family and unskilled hired labour. Machine operating costs was considered, too (BROWN et al. 1985).

Crop prices that farmer had got were obtained from State Institute of Statistics Prime Ministry Republic of Turkey.

The data obtained in this study were subjected to analysis of variance (ANOVA) and the differences between means were compared using LSD test.

Results and Discussion

In both years, the cropping systems showed no significant differences in terms of fruit weight, fruit number per plant, and early and total yield of eggplant in intercropping compared to sole cropping (Table 1). Similar findings in different species were reported in intercropping of tomato:bean (SUBHAN 1991) and of lettuce:pea (SHARAIHA and GLIESMAN 1992).

SPLITTSTOESSER (1990) pointed out that short season vegetables as lettuce planted between full season vegetables for complementary depth and spread of root systems preclude serious competition for light, water and nutrients. WOOLLEY and DAVIS (1991) reported that legumes like bean were weaker competitors for growth resources than some other vegetables. Furthermore after intercrops harvest, long term crops such as eggplant may have taken full advantage of all available resources to complete its growth (FUKAI and TRENBATH 1993). Our results were in good agreement with these reports.

Table 1. The effect of sole cropping and intercropping on growth paramenters of eggplant and on Land Equivalent Ratio (LER) and net income.

Cropping system	Fruit weight (g)	Fruit number (per plant)	Early yield (kg m^{-2})	Total yield (kg m^{-2})	Land Equivalent Ratio (LER)	Net income (€/ha)
2000						
Eggplant	155.13	18.60	1.40	5.78	1.00	15290
Eggplant+cos lettuce	151.90	18.05	1.30	5.49	1.11	18360
Eggplant+leaf lettuce	153.53	18.86	1.41	5.79	1.21	16200
Eggplant+bean	154.70	17.46	1.31	5.39	1.12	17645
LSD (0.05)	5.24	2.52	0.20	0.64	0.05	192
2001						
Eggplant	155.67	19.96	1.52	6.21	1.00	11369
Eggplant+cos lettuce	154.13	19.03	1.42	5.86	1.14	13686
Eggplant+leaf lettuce	156.03	19.64	1.47	6.13	1.18	11799
Eggplant+bean	153.90	18.98	1.34	5.84	1.14	13212
LSD (0.05)	5.23	2.56	0.29	0.59	0.02	115

The values of LER with all intercropping systems in the present study were higher than those of sole cropping of eggplant. In both years, the eggplant+leaf lettuce intercropping system gave the highest LER value with 1.21 and 1.18, respectively. Among intercropping systems, eggplant+cos lettuce in 2000, and eggplant+cos lettuce and eggplant+bean in 2001 were the lowest in terms of LER (Table 1).

The high efficiency of intercropping found in this study agreed with the findings of BAUMANN et al. (2001), who explained this phenomenon by the complementary use of growth resources in vegetable production.

This study indicates that the most economically satisfactory intercropping system was obtained with the eggplant+cos lettuce system. In addition, bean and leaf lettuce as an intercrop increased the net income compared to sole eggplant in both years (Table 1). Thus, intercropping systems of plants with different size, suitable under and above ground architecture, and different growth cycle may be more productive and reminerative and they can use the resources like light, water and nutrients more efficiently than with sole cropping (VARGHESE 2000).

References

BAUMANN, D.T., M.J. KROPFF and L. BASTIAANS 2000: Intercropping leeks to suppress weeds. Weed Research. **40**, 359–374.

BAUMANN, D.T., L. BASTIAANS and M.J. KROPFF 2001: Competition and crop performance in a leek-celery intercropping system. Crop Sci. **41**, 764–774.

BROWN, J.E., W.E. SPLITTSTOESSER and J.M. GERBER 1985: Production and economic returns of vegetable intercropping systems. J. Amer. Soc. Hort. Sci. **110**, 350–353.

FUKAI, S and B.R. TRENBATH 1993: Processes determining intercrop productivity and yields of component crops. Field Crops Res. **34**, 247–271.

GUNAY, A. 1993: Vegetable growing. Cilt II. Serler. Çað Matbaasý, Ankara, Turkey

HOCHMUTH, G., B. HOCHMUTH, E. HANLON and M. DONLEY 1991: Nitrogen requirements of mulched eggplant in northern Florida. Fla. Agr. Expt. Sta. Research Report, Suwannee Valley REC. 91–114.

MIDMORE, D.J. 1993: Agronomic modification of resource use and intercrop productivity. Field Crops Res. **34**, 357–380.

SHARAIHA, R. and S. GLIESSMAN 1992: The effects of crop combination and row arrangement in the intercropping of lettuce, fava bean and pea on weed biomass and diversity and on crop yields. Bio. Agric. and Hort. **9**, 1–13.

SPLITTSTOESSER, W.E. 1990: Vegetable Growing Handbook. An Avi Book published by Van Nostrand Reinhold, New York, USA, 362 p.

SUBHAN, I. 1991: Effect of intercropping with *Phaseolus vulgaris* L. on growth and yield of tomato *Solanum lycopersicum* L.. Hort. Abstr. **61**, 2863.

VANDERMEER, J. 1989: The ecology of intercropping. Cambridge University Press, Cambridge, UK, 237 p.

VARGHESE, L. 2000: Indicators of production sustainability in intercropped vegetable farming on montmorillonitic soils in India. J. of Sust. Agric. **16**(4), 5–17.

WOLLEY, J and J.H.C. DAVIS 1991: The agronomy of intercropping with beans. In: SCHOONHOVEN, A. and M. OYSET (eds): Common beans: research for crop improvement. CAB International, CIAT, Colombia, 980 p.

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