Egypt. J. Agric. Res., 77 (3) ,1997

INFLUENCE OF WEED INTERFERENCE ON GROWTH, YIELD AND QUALITY OF SUGAR BEET

M.T.B. FAYED[1], I.H. EL-GEDDAWY[2] AND MAHA M. EL-ZENY[2]

1 Fac. of Agric., Ain Shams Univ., Egypt.

2 Sugar Crops Res. Institute., Agric. Res. Cent., Giza, Egypt.

(Manuscript received 16 July 1998)

Abstract

Weed interference exerted a drastic reduction on plant height, number of leaves and leaf area of vegetative parts, as well as dimensions, size, fresh and dry weights and RGR of root and consequently economic yield of sugar beet plant. The extent of reduction was dependent on the associated weed species. Accordingly, it is possible to produce tentative ranking of competitive abilities of the seven weed species under investigation as following: highly competitve: wild beet, canarygrass and bermudagrasss; moderately competitive: dock weed and tooth pick and poorly competitive: lambsquarters and bindweed.

Sucrose %, T.S.S. and nutrient (N, K and Na) concentration values of beet root juice were higher in weed-free treatment than the weedy ones. The higher competitve weeds (wild beet, canarygrass and bermueda-grass) were also the most effective competitors for N, K and Na nutrients uptake, but it was not as effective on T.S.S. and surcrose Values.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) could not be grown economically without weed control, because the rate of initial beet growth is very slow that the crop is unable to compete efficiently with weeds.

Evidently, weeds cause an impairment impact on growth and productivity of sugar beet plant (Vargas and Gamboa 1985; El-Titi 1986; Schaufele 1986; Shiyan et al 1986; Hovath et al 1987; Kropff et al 1987 and Lotz et al 1992). There was a close relationship between the decrease in the light intensity caused by the weeds and sugar beet weight (Schaufele 1986 and Hovath et al 1987), Therefore, Kropff et al (1987) found that *Chenopodium album* was stronger competitor than *Stelleria media* because *C.album* grew taller than sugar beet crop. Accordingly, the restricted leaf growth due to competition of light impaired sugar beet root production (Hovath et al 1987). Variation in morphology, life history or development or development of weed species systematically caused differences between predicted and observed yield losses (Lotz et al 1985); 50.3-75.2% (Shiyan et al 1986) or 60-80% (Er and Inan 1987). Species, density, distribution duration of weeds were the main factors in determing the severity of both competition and crop losses (Zimdahl 1993).

Juice quality of sugar beet may be affected also by the interference of weeds. Schweizer and Lauridson (1985) deduced that recoverable sucrose of sugar beet decreased as the density of Amaranthus powelli increased. The uptake of N, Na and K was markedly decreased in sugar beet infested with weeds (Matushkin et al 1987). On the contrary, many investigators showed that weeds did not affect sugar content (El-Titi 1986); T.S.S. (Abd El-Aal 1995) and the the concentrations of sugar (sucrose), K, Na, alpha amino nitrogen or invert sugar in the crop beets (Longden 1989).

The present study was conducted in attempt to diagnose the hazardous impacts of associated weed species on growth, yield and quality of their neighbouring sugar beet plant.

MATERIALS AND METHODS

To evaluate the deletrious effects of associated weed species on productivity and quality of sugar beet, two pot trials were carried out in Sugar Crops Research Institute, Giza Research Station in the successive seasons of 1992/93 and 1993/94.

Each experiment was consisted of 8 treatments which included 7 weed species/sugar beet interference treatments, in addition to the control (weed-free) one. Weed species under investigation are the common ones in sugar beet fields at Kafre El-Sheikh governorate. The seven weed species were: wild beet (*Beta Maritima* L.); Lambsquarters (*Chenopodium murale* L.); dock weed (*Rumex dentatus* L.) tooth pick (*Ammi majus* L.); canarygrass (*phalaris minor* Retz.); bindweed (*Convolvulus anrvenis* L.) and bermuda-grass (*Cynodon dactylon* (L.) Pers.).

Suitable number of beet and individual weed species seeds were sown on 15th November for the two seasons in pots 50 cm in diameter filled with 20 kg of loamy dry and clean soil. A commercial sugar beet variety "Ras poly" was used in both seasons. One week after beet emergence, crop and weeds were thinned for each pot to maintain one plant of sugar beet against 5 plants of each of the previous 7 weed species. Number of weeds/pot (0.2 m2) represent 1/4 of the normal density of weeds in unweeded plots of sugar beet fields of Sakha Research Station (Abd El-Aal 1995). Treatments were layed out in complete randomized system in 9 replication. Pots were watered as needed and fertilized with the recommend dose of nitrogen (70 kg N/fed.) and potassium (50 kg K_2O/fed.).

Data recorded after 105, 135 and 180 days (at harvest) from planting (3 pots for each) on the following criteria of beet plant: plant height (cm); number of leaves/plant; leaf area (cm2/plant), length (cm), diameter (cm) and size (cm3) of root; fesh and dry weights of root/plant (g) and relative growth rate (RGR) of roots in mg/g./day (Watson 1952). Data on juice quality included: T.S.S. by hand refractometer; sucrose% (Le Docte 1927); total N% (Pergl 1945) and K% and Na% (Brown and Lilliand 1946).

Data were subjected to proper statistical analysis of complete randomized design according to procedure outlined by Snedecor and Cochran (1967). L.S.D. at 0.05% level of probability was used to compare between means (Waller and Duncan 1969).

RESULTS AND DISCUSSION

A. Effect of weed interference on vegetive growth characteristics of sugar beet

Data presented in Table (1) show that all weeds uunder investigation reduced to different extents height, number of leaves and leaf area of neighbouring sugar beet plant than the control. Canarygrass, bermuda-grass and wild beet were the highest competitors. They reduced significantly the height of crop plant than the weed-free ones, after 105 days from sowing by 32.8, 31.3 and 28.3%, after 135 days by 30.9, 30.9 and 29.1% and after 180 days from sowing by 28.2, 28.2 and 30.1%, respectively with no significant differences between them.

Canarygrass was more effective in reducing number of leaves/plant at the 1st sample, whereas wild beet was the most potent weed in this regard at both the 2nd and 3rd assessment. Evidently, canarygrass, wild beet and bermuda-grass were the more impairment weed species on number of leaves and leaf area of sugar beet plant. Wild beet, cangrygrass and bermuda-grass interference diminished sugar beet leaf area than that of weed-free plant in the 1st assessment by 58.8, 55.1 and 43.3%; in the 2nd sample by 59.6, 47.1 and 42.4% and in the 3rd one by 93.2, 85.1

and 80.5%, respectively. Reduction in leaf area herein is mainly attributed to the deleterious impact of weed interference on number of leaves/plant (Table 1) and or on average areas per leaf.

Table 1. Effect of weed interference on height, number of leaves, and leaf area of sugar beet plant (combined analysis of 1992/93 and 1993/94 experiments).

Associated weed species	Plant height (cm)			Number of leaves / plant			Leaf area/plant (cm3)		
	Days after sowing			Days after sowing			Days after sowing		
	105	135	135	105	135	135	105	135	180
Wild beet	19.0	27.5	29.5	11.0	14.7	22.5	2158.7	2551.2	333.6
Lambsquarters	23.3	34.8	37.5	13.3	24.2	34.5	3925.0	4968.3	2296.1
Dock weed	20.3	32.5	36.2	12.3	22.7	28.7	3402.1	3983.9	2099.9
Tooth pick	20.2	32.0	36.7	12.3	23.5	34.8	3167.5	4500.4	2374.6
Canarygrass	17.8	26.8	30.3	11.5	18.3	27.7	2354.3	3336.2	726.1
Bindweed	22.8	33.8	38.0	7.2	27.0	29.0	4121.2	5139.	2786.7
Bermuda-grass	18.2	26.8	30.3	13.7	22.5	25.0	2970.8	3632.5	951.8
Weed free (control)	26.5	38.8	42.2	11.2	29.8	43.7	5244.7	6309.0	4886.6
L.S.D. at 5% level	3.23	7.68	11.77	2.41	5.6	8.67	171.1	297.7	414.6

The above mentioned results sustained the deterimental effects of weed interference on vegetative growth parameters of sugar beet. However, weed species differeed in their competing abilities against sugar beet plant. Canarygrass, wild beet and bermudagrass seems to be the most harmful competitors. Exclusion of light by the taller and the high tillered weeds such as canarygrass or by taller broad leaf weeds such as wild beet may be responsible for the competitiveness of these weeds against sugar beet. In addition, wild beet weed is similar in growth habitat of sugar beet plant. Weeds of similar growth habit to the crop plant are often more serious competitiors than weeds of dissimilar habit. Therefore, Muzic (1970) deduced that grass weeds compete more with cereal crops because they tend to have roots of similar spread and depth, and broad leaf weeds compete more with broad leaf crops, on the other hand, it is worthy to notice that bermuda grass is a C4 "efficient" plant and are naturally more competitive because it can fix Co2 at much higher rates than non-efficient plants (Black et al 1969).

Table 2. Effect of weed interference on length, diameter and size of sugar beet root (combined analysis of 1992/93 and 1993/94 experiments).

Associated weed species	Root length (cm)			Root diameter (cm)			Root size (cm3)		
	Days after sowing			Days after sowing			Days after sowing		
	105	135	180	105	135	135	105	135	180
Wild beet	15.7	17.8	22.7	1.9	3.0	5.6	14.6	41.4	184.4
Lambsquarters	22.8	27.3	29.9	2.4	6.7	11.0	34.0	317.5	971.7
Dock weed	17.5	24.0	25.9	2.0	5.2	9.1	18.1	168.1	582.3
Tooth pick	16.8	21.0	29.7	2.1	6.3	10.3	18.8	213.8	821.7
Canarygrass	9.5	18.3	24.0	1.2	3.5	8.7	5.9	58.1	555.6
Bindweed	21.3	25.7	31.0	2.7	7.0	10.6	40.2	326.2	698.6
Bermuda-grass	16.5	20.8	23.7	2.0	4.5	5.7	17.4	110.2	199.5
Weed free (control)	23.8	33.5	39.2	3.3	8.5	12.0	67.1	626.9	1462
L.S.D. at 5% level	4.15	5.85	7.17	0.5	1.14	4.93	11.3	116.0	451.4

(B) Effect of weed interference on root growth of sugar beet,

Weed interference decreased to different extents the growth criteria of sugar beet root (Table 2 & 3). The greatest rate of reduction in root dimensons (lenght & diameter) and size was mostly concomitant at the first assessment sample to canarygrass and latter to wild beet (Table 2). The greatest reductions in fresh and dry weights of sugar beet roots were obtained from canarygrass, wild beet, bermuda grass and dock weed. Contrarily, bindweed and lambsquarters were the weakest competitors, whereas tooth pick was in-between (Table 3).

Relative growth rate (RGR) values of sugar beet roots were markedly decreased under weed interference conditions (Table 3). The reduction reached the 5% level of significance only at the 2nd estimation (135-180 days from sowing) except for lambsquarters and bindweed. Canarygrass along with wild beet and bermuda-grass attained the significantly greatest depressing impact on RGR values.

It is evident that weeds exerted a drastic reduction on dimensions, size, fresh

(C) Effect of weed interference on juice quality of sugar beet

Total Soluble Solids (T.S.S), sucrose percentage and nutrient (N, K, Na) concentrations of sugar beet root represents the most important parameters for juice quality. They have a direct and indirect impact on sugar extraction.

Data presented in Table (4) indicate that T.S.S. and sucrose % were greater in weed-free treatment compared with weedy treatment. All weed species exerted a significant reduction in values of T.S.S. and sucrose % of beet juice after 105, 135 and 180 days from sowing with few exceptions. It is worthy to notice that the highly competitor weed species in this investigation (canarygrass, wild bee and bermudagrass) were not the potent treatments in this respect. Meaningly, the highly competitive weed species were not the most effective on sucrose % values.

Existing weeds explotied the environmental resources and retarded growth and development of sugar beet plant. Consequently decreased assimilation and storage process which in turn reflected on the amount of stored sugar in root tissues. Confirming results in this respect were obtained by Dawson (1965); and lauridson (1985) and Abd El-Aal (1995).

Table 4. Effect of weeds interference on juice quality of sugar beet (combined analysis of 1992/93 and 1993/94 experiments).

Associated weed species	T.S.S % Days after sowing			Sucrose % Days after sowing		
	105	135	180	105	135	180
Wild beet	17.0	18.2	21.5	9.1	11.8	13.9
Lambsquarters	16.5	18.5	20.8	8.8	10.6	12.6
Dock weed	16.7	18.2	20.0	9.4	11.7	12.4
Tooth pick	16.0	19.3	21.5	9.5	12.6	12.9
Canarygrass	17.3	19.0	21.3	10.5	12.6	13.9
Bindweed	16.8	18.0	19.5	9.4	10.4	13.0
Bermuda-grass	16.7	18.3	21.0	9.8	11.3	12.5
Weed free (control)	18.0	20.2	22.3	10.9	13.4	15.6
L.S.D. at 5% level	0.52	0.64	1.20	0.53	1.73	1.92

N, K and Na contents of sugar beet root were almost higher in weed-free treatment than weedy one (Table 5). The greatest depressing effect for N% at harvest were amounted to 30.9 and 30.2% and obtained by canarygrass and lambsquarters interference treatments, respectively. Wild beet was the most potassium competitor weed species along the growing season of sugar beet plant. Such weed decreased K content of beet root juice at harvest by 23.3%. On the other hand, bindweed seems to be the weakest competitor species on potassium. Meanwhile, the highest significant reduction in Na than the control was attained by bermuda-grass in the 1st sample, tooth pick along with bermuda-grass and wild beet in the 2nd assessment and wild beet in the 3rd one. Reductions in Na content which were obtained by the former weed species than their contros were estimated by 36.2, 56.0, 51.8, 40.1 and 78.3%, respectively.

Previous findings in Table (5) propose that wild beet, canarygrass, bermuda grass and dock weed are the more dangerous species in sugar beet because of their high nutrient requirement and their aggressiveness in absorbing more nutrients. It is worthy to notice that weeds also the dangerous on growth, yield and quality of sugar beet plant (Tables 1-4). Zimdahl (1993) explained that competition for light affects growth, which in turn affects a plants ability to compete for nutrients and water. Similar trends has been obtained by Asher and Ozanne (1967); Evans (1977) and Matushkin et al (1987).

Table 5. Effect of weeds interference on total nitrogen, potassium and sodium percentages in sugar beet root (combined analysis of 1992/93 and 1993/94 experiments).

Associated weed species	Nitogen %			Potassium %			Sodium %		
	Days after sowing			Days after sowing			Days after sowing		
	105	135	180	105	135	180	105	135	180
Wild beet	2.417	1.483	0.763	2.228	1.552	1.375	0.632	0.385	0.090
Lambsquarters	2.267	1.833	0.725	2.427	1.862	1.733	0.645	0.443	0.332
Dock weed	2.467	1.917	0.857	2.235	2.250	1.687	0.685	0.495	0.375
Tooth pick	2.650	1.517	0.827	2.508	2.047	1.660	0.625	0.283	0.277
Canarygrass	2.64	1.700	0.717	2.375	1.980	1.657	0.617	0.497	0.372
Bindweed	2.583	1.933	0.953	2.542	2.213	1.802	0.548	0.485	0.375
Bermuda-grass	2.183	1.733	0.758	2.362	2.043	1.548	0.453	0.310	0.208
Weed free (control)	2.683	1.967	1.038	2.682	2.357	1.792	0.170	0.643	0.415
L.S.D. at 5% level	0.140	0.265	0.321	0.191	0.213	0.414	0.108	0.167	0.236

REFERENCES

1. Abd El-Aal, A.M. 1995. Integrated weed control in sugar beet with relation to yield and quality. M. Sc. Thesis, Fac. of Agric., Ain Shams Univ.
2. Asher, C.J. and P.G. Ozanne. 1967. Growth and potassium content of plants in solution culture maintrained at constant potassium concentration. Soil Sci. 103-155-161.
3. Black, C.C., T.M. Chen and R.H. Brown. 1969. Biochemical basis for plant comption. Weed Sci., 17: 338-344.
4. Brown, J.D. and O. Lillian. 1946. Rapid determination of potassium and sodium in plant material and soil extraction by flame photometry. Proc. Amer. Sec. Hort. Sci., 48: 341-346.
5. Dawson, J.H. 1965. Competition between irrigatted sugar beets and annual weeds. Weeds, 13: 245-249.
6. El-Titi, A. 1986. Weed competition in sugar beet and its practical utilization. Zeitshrift Fur Pflanzen-Krankheiten und pflanzenschutz 93 (2): 136-145. C.F. Weed Abst. 30, 4296, 1988.
7. Er, C. and H. Inan. 1987. Effects of weed competition on the yield and quality of sugar beet. Seker, (20) 121: 17-29. C.F. Weed Abst. 31, 922, 1989.
8. Evens, P.S. 1977. Comparative root morphology of some pasture grasses and clovers. Newzaland Jour. Of Agric. Res. 20 : 331-335.
9. Hovath, K., G. Czimber, L. Csiba and P. Suke. 1987. Dominance and injurious effects of abutilon (*Abutilon theophrasti* Medik.) in sugar beet at the Educational state fram lajta-hamsay. Mosonmagyarovari Mezogazdsagtudomanyi Kar Kozlemenyei, 29 (1). C.F. Weed Abst. 32, 1769-1989.
10. Kropff M.J., W.Joenje, L. Bastiaans; B. Habekotte; H. Van, Oene and R. Werner. 1987. Competition between a sugar beet crop and populations of *Chenopodium album* L. and *Stellaria media* L., Nether lands, J. of Agric. Sci. 35 (4): 525-528.
11. Le-Docte, A. 1927. Commercial determination of sugar in the beet root using the So. Chs. Le-Doct. Process. Intern. Sugar J. 29: 488-492.
12. Longden, P.C. 1989. Effects of increasing weed-beet density on sugar beet yield and quality. Ann. Of Applied Biol. 114 (3): 527-532.

13. Lotz, L.A.P., M. J. Kropff; B. Bos and J. Wallinga. 1992. Prediction of yield loss based on relative leaf cover of weeds. Weed Sci. Society of Victoria, Vol. 2: 290-292.

14. Matushkin, C.I., V.D. Kunak and A.A. Ivashenko. 1987. Modelling weed control systems in sugar beet. Sakharnaya-sevekla. No. 11: 37-42. C.F. Field Crop Abst. 33, 8320, 1988.

15. Muzik, T.J. 1970. Weed Biology and Control. Mc Grow-Hill Book comp.

16. Pergl, F. 1945. Quantative Organic Micro Analysis 4th ed., J. and Churchill LTP. London.

17. Schaufele W.R. 1986. Effect of a high-growing weed (*Chenopodium alhum*) on development and yield of sugar beet. Zeitschrift fur pflanzenkrankheiten und pfianzenschutz. 93 (2): 125-135. C.F. Field Crop Abst. 22, 1913, 1989.

18. Schweizer, E.E. and T.C. Lauridson. 1985. Powell amaranth (Amaranthus powellii) interference in sugar beet (Beta vulgaris). Weed Sci. 33 (4): 518-520.

19. Shiyan, P.N., A.N. Lyashenko and B.T. Prokopchuk. 1986. Competition between sugar beet and weeds for nitrogen. Khimiya V Selskom Lhozyaistve 24 (1): 41-44. C.F. Weed Abst. 33, 3260, 1988.

20. Snedecor, G.W. and W.G. Cochran. 1967. Statistical Methods. 6th Ed., Iowa State Univ. Press, Ames., Iowa, USA.

21. Vargas, L.A. and C.J. Gamboa. 1985. Critical period of competition between weeds and (Beta vulgaris L.) De Costarica. San Jons. C.F., Weed Abst. 32, 3205, 1988.

22. Waller, R.A. and D.B. Duncan. 1969. A bays rule for the symmetric multiple comparison problem. Amer. Stat, Assoc. J., Dec., 1485-1503.

23. Watson, D.J. 1952. The physiological basis of variation in yield. Adv. Agron. 4: 101-145.

24. Zimdahl, R.I. 1993. Fundamentals of Weed Science Academic Press. Inc. San Diego-Boston.

تأثير تداخل الحشائش علي نمو ومحصول وجودة بنجر السكر

طاهر بهجت فايد١، إبراهيم حنفي الجداوي٢، مها محمد الزيني٢

١ قسم المحاصيل كلية الزراعة جامعة عين شمس – شبرا – مصر.

٢ قسم المعاملات الزراعية – معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – مصر

أحدث تداخل نباتات الحشائش مع بنجر السكر إنخفاضا واضحا في إرتفاع النباتات وعدد ومساحة الأوراق للمجموع الخضري وفي الأبعاد والحجم والوزن الغض والجاف والمعدل النسبي للنمو للمجموع الجذري لنباتات البنجر وانعكس ذلك بالتالي في إنخفاض كمية المحصول – وتباين معدل هذا الإنخفاض تباينا واضحا باختلاف نوع الحشيشة المصاحبة لنباتات البنجر بما يمكن معه تقسيم الأنواع السبعة للحشائش تحت الدراسة نسبيا في قدرتها التنافسية لبنجر السكر إلي:

حشائش قوية التنافس : السلق، الفلارس، النجيل البلدي – حشائش متوسطة التنافس الحميض، الخلة – وحشائش ضعيفة التنافس : الزربيح والعليق.

أحدث تداخل أنواع الحشائش إنخفاضا في قيم صفات جودة عصير جذور البنجر (النسبة المئوية للسكروز، نسبة المواد الصلبة الذائبة الكلية، نسب عناصر النتروجين والبوتاسيوم والصوديوم) وكانت الحشائش الثلاث السابق ذكرها كحشائش عالية التنافس (السلق ، الفلارس، النجيل) هي أيضا أكثر الحشائش إستنزافا للعناصر الغذائية وخفضا لمستوي عناصرن ، بو ، ص في جذور البنجر بينما لم تكن هذه الحشائش نفسها الأكثر تأثيرا في خفض قيم صفتي النسبة المئوية للسكروز، ونسبة المواد الصلبة الذائبة الكلية.