EFFECT OF SUGAR BEET INTERFERENCE ON SOME GROWTH TRAITS OF THE COMMON ASSOCIATED WEEDS

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Abstract

Two pot trials were conducted in Sugar Crops Research Institute, Giza Research Station, ARC, Egypt in the two successive seasons of 1992/93 and 1993/94. The purpose of this work was to assess the effect of sugar beet interference (1 sugar beet : 5 weed plants ratio) on growth characteristics of above and sub-soil parts some common associated weed species.

Sugar beet exerted noticeable reductions in height, number of branches and leaves fresh and dry weights of foliage and underground parts/plant of existing weed species after 105, 135 and 180 days from sowing. The extent of reductions was mainly dependent on the neighbouring weed species.

Shoot growth reduction was more striking with bindweed (Convulvulus arvensis, L.), followed by wild beet (Beta vulgaris, L.). Sugar beet interference decreased the number of branches and leaves and fresh and dry weights of aerial parts of bindweed plant than the control after 135 days from sowing by 61.4, 63.2, 78.3 and 74.7% respectively. Contrarily, canarygrass (Phalaris minor Retz.) can withstand competition of sugar beet without any significant reductions in its shoot growth. Other weed species: dock weed (Rumex dentatus L.); lambquarters (Chenopodium murale L.); tooth pick (Annuin maues L.) and bermuda-grass (Cynodon dactylon (L.) Pers.) were in-between.

Hazardous impact of beet interference on underground parts of weeds was more pronounced with dock weed followed by wild beet and lambquarters, whereas tooth pick was the only non-affected weed by sub-soil competition.

INTRODUCTION

Competition stress between crop plants and associated weeds is a critical factor affecting growth of field crops and their productivity. Accordingly, the deleterious reciprocal impacts between sugar beet plant associated weed species on growth of both and productivity of crop plant were important and interesting.
A lot of published papers threw the lights on the effect of weed interference on sugar beet, whereas few ones discussed the antagonistic impact of sugar beet interference on growth of weeds.

The competitive effect of crops and weeds on each other may depend on when and how fast each starts growing in relation to the other. The relative speed of germination, establishment at early growth are therefore important in determining the outcome of competition (Zimdahl 1993).

Weed species materiality differ in their tolerance to beet interference (Dawson 1965, Weatherspoon and Schweizer 1997 and Lotz et al 1992). Sugar beet competition delays maximum LAI for one month in Amaranthus retroflexus and reduced LAI but not growth rate in Chenopodium album. Therefore, sugar beet proved more competitive than A. retroflexus (Pozsgai 1988). In addition, Dawson (1965) pointed out that full-season competition from the beets reduced bermuda-grass yield 70% but lambsquarters only 13%.

The main target of this investigation was to detect the antagonistic effect of sugar beet interference on growth characteristics of its associated weed species.

**MATERIALS AND METHODS**

Two pot trials were conducted in Sugar Crops Research Institute, Giza Research Station, Agricultural Research Center in the two successive seasons of 1992/93 and 1993/94. Associated sugar beet weeds under investigation include: wild beet "Beta vulgaris" L. dock weed "Rumex dentatus" L.; Lambquarts "Chenopodium murale" L.; tooth pick" Ammi majus L."; canarygrass "Phalaris minor" Retz; bindweed "Convolvulus arvensis" L. and bermuda-grass "Cynodon dactylon" (L.) Pers. Suitable number of sugar beet and individual weed species seeds were sown on 15th November for the two seasons in pots 50 cm in diameter and 42 cm in height and filled with 20 kg/pot of loamy dry and clean soil. A commercial sugar beet variety viz "Ras Poly" was used in both seasons. One week after sugar beat emergence, crop and weeds were thinned for each pot to maintain one plant of sugar beet against five 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). Each experiment was consisted of 14 treatments which include the seven weed species accompanied with sugar beet and the seven treatments of weeds alone. Treatments were layed out in complete ran-
domized design in 9 replications.

Pots were watered as needed and fertilized with the recommended rate of nitrogen and potassium (70 kg N and 50 kg K2O/ha, respectively). Data recorded after 105, 135 and 180 days (at harvest) from planting (3 pots for each) on the following weed growth criteria: plant height (cm); no. of branches/plant; no. of leaves/plant and fresh and dry weights of above and underground parts (g)/plant. Data were statistically analyzed as described by Snedecor and Cochran (1967).

Calculated values of T at 0.05 were used to compare growth criteria measurements of weeds with and without sugar beet. Combined analysis of the two seasons data were followed, since the same general trends of results were noticed.

RESULTS

1. Height and number of branches and leaves of weed plants:

Data presented in Table 1 indicate that sugar beet interference had no significant impact on height and number of branches/plant of associated weeds. These results were true after 105 and 180 days old and of bindweed at the three assessments. Sugar beet interference reduced number of branches of wild beet plant 105 and 180 days old than those free of crop by 49.5 and 22.6%, respectively. Reduction percentages in the same trait for bindweed at 105, 135 and 180 days old were 47.9, 61.4 and 51.7%, respectively. Meaningly, branching initiations in wild beet and bindweed plants were more seriously affected by shading and other interference elements of sugar beet plant.

The significant effect of sugar beet interference on number of leaves per weed obvious. This finding was true at the two sampling periods and for all weed species except canarygrass. It is worthy to notice that most of leaves of all weed plants were enesceded and died at the third assessment (180 days from sowing) thereby, data of such sample were excluded. Sugar beet interference reduced significantly number of leaves/weed plant than those free of crop plant after 105 and 135 days by 29.8 and 59.3% for wild beet; 55.3 and 25.4% for lambsquarters; 31.6 and 32.7% for dock weed; 23.4 and 40.4% for tooth pick; 47.3 and 6.2% for bindweed and 26.3, and 54.9% for hembuda-grass, respectively. Apparently, bindweed followed by wild beet (135 days old) were the more damaged species in this respect. Sensitivity of bindweed and wild beet to sugar beet interference reduced number of
Table 1. Effect of sugar beet plant interference on height (cm), number of branches and number of leaves of studied weeds.

<table>
<thead>
<tr>
<th>Year</th>
<th>1993</th>
<th>1994</th>
<th>1995</th>
<th>1996</th>
</tr>
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<tr>
<td>clinic</td>
<td>105</td>
<td>115</td>
<td>118</td>
<td>120</td>
</tr>
<tr>
<td>height (cm)</td>
<td>160</td>
<td>163</td>
<td>165</td>
<td>168</td>
</tr>
<tr>
<td>number of branches</td>
<td>110</td>
<td>113</td>
<td>116</td>
<td>119</td>
</tr>
<tr>
<td>number of leaves</td>
<td>110</td>
<td>113</td>
<td>116</td>
<td>119</td>
</tr>
</tbody>
</table>

Combined analysis of 1993 and 1994 experiments.
branching and this in turn decreased the number of their leaves/plant.

2- Fresh and dry weights of vegetative parts:

Sugar beet interference decreased significantly fresh and dry weights of vegetative parts of associated weeds after 105, 135 and 180 days. This finding was true for all weed species under investigation except for canarygrass at the three assessments, lambsquarters at the 3rd sample and toothpick at the 2nd one (Table 2).

Fresh weight of vegetative parts of weeds after 105, 135 and 180 days from sowing was considerably greater for crop-free pots than for those in which the weeds were subjected to normal competition from the sugar beet plant. Such increases amounted to 57.1, 111.2 and 267.3% for wild beet, 160.2, 102.4 and 25.3% for lambsquarters; 58.2, 102.7 and 62.0% for dock weed; 166.7, 26.3 and 55.8% for toothpick; 154.5, 361.1 and 266.7% for bindweed and 59.5, 124.3 and 106.3% for bermuda-grass, respectively. In the same trend dry weights of foliage parts of weeds were reduced in presence of sugar beet interference than in those cropfree by 53.9, 69.1 and 67.5% for wild beet; 66.7, 38.9 and 25.6% for lambsquarters; 30.3, 50.7 and 39.9% for dock weed; 56.6, 36.8 and 27.3% for toothpick; 61.4, 74.7 and 72.5% for bindweed and 47.9, 57.2 and 50.9% for bermuda-grass after 105, 135 and 180 days from sowing, respectively. These results suggested that bindweed followed by wild beet were the more susceptible weeds to sugar beet interference whereas canarygrass was not significantly affected by such stress. The rest of weed species were in-between. Reduction in fresh and dry weights of vegetative parts of weeds herein could be attributed to the obvious reduction in the number of leaves and branches/plant of such weed species (Table 1).

3. Fresh and dry weights of underground parts:

Fresh and dry weights of underground parts of weeds were considerably lower under sugar beet interference condition than under crop-free one. These results were true for all weed species under investigation at the three assessments except for canarygrass and bermuda-grass at the 1st sample and toothpick at the three assessments (Table 3).

Sugar beet interference decreased fresh weight of sub-soil parts of associated weeds than those of crop-free weeds after 105, 135 and 180 days from sowing by 32.8, 45.3 and 57.9% for wild beet; 58.3, 46.2 and 30.8% for lambsquarters; 63.5, 50.5 and 45.0% for dock weed; 28.3, 49.7 and 39.4% for canarygrass; 57.1,
64.0 and 15.2 for bindweed and 41.2, 44.0 and 32.9% for bermuda-grass, respectively. Finding values revealed that roots of dock weed followed by wild beet followed by wild beet and lambsquarters were the most sensitive weeds for sugar beet interference, whereas tooth pick was the only non affected weed by such competition.

It could be concluded that under the conditions of the experiment, sugar-cane showed higher competitive abilities for the soybean and sorghum indicating that sugar-cane could be considered a good components when intercropping with soybean or sorghum, in other words sugar-cane crop was dominant in the three intercropping patterns.

**DISCUSSION**

The forementioned results demonstrated that sugar beet exerted a drastic reduction in height, number of branches and number leaves and fresh and dry weights of shoot and root parts weed plant of existing weed species. However, the extent of reduction was mainly dependent on the neighbouring weed species. The hazardous impact of sugar beet interference on growth criteria of aerial parts (no. of branches and leaves and fresh and dry weights of shoots/plant) of weeds were more pronounced with bindweed followed by wild beet, whereas canarygrass was less sensitive in this regard. Meaningly, the fitness of shoot competition of sugar beet on bindweed is striking, whereas canarygrass can withstand competition of sugar beet without any significant reductions in its shoot growth.

On the other side the reduction in fresh and dry weights of roots were more pronounced with dock weed, wild beet and lambsquarters, whereas tooth pick root was not statistically harmed by such interference.

High sensitivity of aerial parts of bindweed to sugar beet interference could be attributed to the larger vigorosity of crop plant expressed in height and leaf area per sugar beet plant ability to intercept light is higher and have a competitive advantage for light bindweed. In this respect Lotz et al. (1991) suggested that competition for light is the main factor explaining the observed crop effects on the population dynamics of the weeds.

Accordingly a heavily shaded plants (bindweed) suffers reduced photosynthesis, leading to poor growth. On the contrary, growth criteria of vegetative parts of
Table 2. Effect of sugar beet plant interference on fresh and dry weights (g/plant) of vegetative parts of studied weeds.

[Combined analysis of 1992/93 and 1993/94 experiments].

<table>
<thead>
<tr>
<th>Growth characteristics</th>
<th>Days after planting</th>
<th>Wild beet</th>
<th>Lambsquarters</th>
<th>Dock weed</th>
<th>Toothpick</th>
<th>Canarygrass</th>
<th>Bindweed</th>
<th>Bermuda-grass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>With sugar beet</td>
<td>Alone</td>
<td>T value</td>
<td>With sugar beet</td>
<td>Alone</td>
<td>T value</td>
<td>With sugar beet</td>
</tr>
<tr>
<td>Fresh weight</td>
<td>105</td>
<td>52.4</td>
<td>82.3</td>
<td>2.93</td>
<td>14.8</td>
<td>38.5</td>
<td>4.36</td>
<td>35.6</td>
</tr>
<tr>
<td>(g/plant)</td>
<td>135</td>
<td>84.2</td>
<td>177.8</td>
<td>4.55</td>
<td>25.1</td>
<td>51.4</td>
<td>5.43</td>
<td>86.6</td>
</tr>
<tr>
<td>Dry weight</td>
<td>180</td>
<td>36.4</td>
<td>133.7</td>
<td>6.40</td>
<td>7.9</td>
<td>9.9</td>
<td>N.S.</td>
<td>46.3</td>
</tr>
<tr>
<td>(g/plant)</td>
<td>105</td>
<td>15.5</td>
<td>33.6</td>
<td>3.57</td>
<td>2.3</td>
<td>6.9</td>
<td>4.36</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>135</td>
<td>29.1</td>
<td>91.2</td>
<td>4.52</td>
<td>4.4</td>
<td>7.2</td>
<td>5.15</td>
<td>20.9</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>34.7</td>
<td>106.9</td>
<td>6.41</td>
<td>5.8</td>
<td>7.8</td>
<td>N.S.</td>
<td>38.4</td>
</tr>
</tbody>
</table>
canarygrass was not materially affected by sugar beet interference. Superiority of canarygrass in plant height, tillering, relative growth rate and aggressivity Zimdahl (1993) could be interpreted as this findings.

Noticeable sensitivity of dock weed, lambsquarters and wild beet roots to sugar beet interference may be attributed to some advantages in rooting depth, feeding diameter and feeding area per plant of sugar beet than weeds. In addition, similarity in root system between sugar beet and each of dock weed, lambsquarters and wild beet as dicotyledonous tap root plants must be also considered. In this respect Muzik (1970) indicated that severe competition occurs if roots of crops and weeds are concentrated in the same soil areas. Confirmed results on the importance of root competition were reported by Wilson (1988) who found that in 33 out of 47 species interactions, root competition had a greater effect than shoot competition but, interestingly, the exceptions typically involved crop-weed interactions.

Results on the variation between weed species in their tolerance to crop interference are in close agreement with those reported by Dawson (1965); Black et al (1969); Weatherspoon and Schweizer (1971) and Lotz et al. (1991).

Competition impacts of crop interference on growth indices of certain weeds can be utilized in weed management programs. Sensitive weed species can easily suppressed by their neighbouring rotational competitive crops. Such method can be integrated with mechanical and chemical weed control methods to achieve a suitable and effective strategies for weed control in field crops.
Table 3. Effect of sugar beet plant interference on fresh and dry weights (g/plant) of underground parts of studied weeds. [Combined analysis of 1992/93 and 1993/94 experiments].

<table>
<thead>
<tr>
<th>Growth characteristics</th>
<th>Days after sowing</th>
<th>Wild beet</th>
<th>Lamb'squarters</th>
<th>Dock weed</th>
<th>Tooth pick</th>
<th>Canarygrass</th>
<th>Bindweed</th>
<th>Bermuda-grass</th>
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<tbody>
<tr>
<td></td>
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<td>With sugar beet</td>
<td>Alone</td>
<td>T value</td>
<td>With sugar beet</td>
<td>Alone</td>
<td>T value</td>
<td>With sugar beet</td>
</tr>
<tr>
<td>Fresh weight (g/plant)</td>
<td>105</td>
<td>8.2</td>
<td>12.2</td>
<td>3.01</td>
<td>1.0</td>
<td>2.4</td>
<td>3.73</td>
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<td>10.5</td>
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<td>7.7</td>
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<td>180</td>
<td>11.5</td>
<td>27.3</td>
<td>4.7</td>
<td>0.9</td>
<td>1.3</td>
<td>3.54</td>
<td>4.5</td>
</tr>
<tr>
<td>Dry weight (g/plant)</td>
<td>105</td>
<td>1.9</td>
<td>2.8</td>
<td>2.51</td>
<td>0.27</td>
<td>0.55</td>
<td>2.74</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>135</td>
<td>3.2</td>
<td>5.4</td>
<td>3.31</td>
<td>0.32</td>
<td>0.67</td>
<td>3.46</td>
<td>2.02</td>
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<tr>
<td></td>
<td>180</td>
<td>8.6</td>
<td>189</td>
<td>4.63</td>
<td>0.53</td>
<td>0.85</td>
<td>4.86</td>
<td>2.92</td>
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</table>
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تأثير تداخل بنجر السكر على بعض صفات النمو لبعض الحشائش الصاحبة

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أجريت تجربة على سبع مجاميع للحشائش السكنية بعيدا بعد 32 يمنين على نبتة بنجر السكر بكمية 100/1000 من الورق، بعد تجربة بحثت على تأثير تداخل بنجر السكر على بعض صفات النمو لبعض الحشائش الصاحبة.

1. قسم العاملات الزراعية - معهد بحوث المصايل السكنية - مركز بحوث الزراعية.