INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 4, p. 121-125, 2014

RESEARCH PAPER OPEN ACCESS

Yield quality as affected by syrup concentration in sugar beet (B*eta vulgaris*): stepwise regression analysis

Hossein Bakhshkandi[1], Bahram Mirshekari[1*], Adel Pedram[2]

[1]*Department of Agronomy and Plant Breeding, College of Agriculture, Tabriz Branch, Islamic Azad University, Tabriz, Iran*

[2]*Research Institute of Urmia, Iran*

Key words: Stepwise regression analysis, linear pattern, alcality value, yield quality.

http://dx.doi.org/10.12692/ijb/4.4.121-25 Article published on February 20, 2014

Abstract

Several species of *Amaranthus* are known to be important weeds that reduce crop yield. For stepwise regression analysis of sugar beet (*beta vulgaris*) traits an experiment was performed with factors of weed densities and planting patterns. In emergence and presence of 12 weed plants per meter row of sugar beet, sodium content in crop roots extract was 3.03%, but only 1.62% from weed free plots. Planting pattern of Zigzag may increase nitrogen content of sugar beet roots significantly. In lower weedy plots syrup purity in roots improved significantly. The alcality value in weed free plots and also in plots with 4 weed plants per meter row of sugar beet was higher than 2. The lower purity was also devoted to 12 redroot pigweed plants per meter row of sugar beet. Mean comparisons indicated that planting pattern of Zigzag could increase molasse sugar concentration of sugar beet roots significantly up to 2.44%, and Zigzag pattern experienced 12.7% reduction in molasse sugar compared to linear pattern. The stepwise regression analysis verified that the percentage of sodium and nitrogen in root, and molasse sugar content had a marked increasing effect on the root yield of sugar beet.

* **Corresponding Author:** Bahram Mirshekari ✉ mirshekari@iaut.ac.ir

Introduction

Several species of *Amaranthus* are known to be important weeds that reduce crop yield (Karimi 2003). Wild oat at a density of 320 plants per meter row reduced sugar yield up to 25-100%. Horak and Loughin (2000) found that early emerging redroot pigweeds were taller with greater biomass than late emerging redroot pigweed.

Mickelson and Harvey (Knezevic *et al.*, 1994) showed that woolly cup grass emerging at the V_5 stage of corn only produced about 40 seeds per plant as compared to 550 to 1760 seeds per plant for early emerging cup grass. Sugar beet root yield decreased as the duration of venice mallow interference increased. The critical timing of weed removal to avoid 5 and 10% root yield loss was 30 and 43 d after sugar beet emergence, respectively. Results show that venice mallow is competitive with sugar beet implying that it should be managed appropriately to reduce negative effects on yield and prevent seed bank replenishment and re-infestation in subsequent years (Dennis *et al.*, 2009).

In another study performed by Dennis *et al.* (2009), percent sucrose content was not affected by wild buckwheat interference. Greater durations of wild buckwheat interference had a negative effect on sugar beet root yield. The critical timing of weed removal to avoid 5 and 10% root yield loss was 32 and 48 d after sugar beet emergence, respectively. These results show that wild buckwheat is competitive with sugar beet and should be managed appropriately to forestall any negative effects on sugar beet root and sucrose yield. This study was conducted to determine the effects of syrup concentration in sugar beet (*beta vulgaris*) on yield quality by stepwise regression analysis.

Materials and methods

Studied factors

The sugar beet hybrid, *Jolgheh*, was sown on 18 May, 2012. The studied factors were redroot pigweed densities (0, 4, 8 and 12 plants per meter row) and planting patterns (zigzag and linear). Plots were irrigated immediately after sowing to assure uniform emergence. Fertilizers used, in spring and before sowing, were 110, 100 and 120 kg ha^{-1} of ammonium phosphate, potassium sulfate and urea, respectively.

Experimental procedure

Field experiment was conducted on a sandy loam soil during 2012 growing season at the Agricultural Research Station of Salmas, East Azerbaijan, Iran, as factorially based on randomized complete block design with three replications.

Measured traits

Measured traits were percentage of Sodium, Nitrogen and Potassium in root, alkality, extraction coefficient, molasse sugar content and yield components. Data from the experiment were compared using the least significant difference test at $P < 0.05$.

Stepwise regression analysis

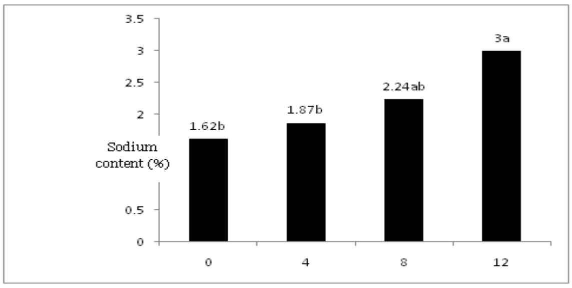
To formulate the relationship between 5 independent quality and growth variables in sugar beet measured in our experiment with a dependent variable, multiple regression analysis was carried out for the percentage of Sodium (X_1), Nitrogen (X_2) in root, alkality (X_3), extraction coefficient (X_4) and molasse sugar content (X_5) as independent variables and root yield as a dependent variable. Furthermore, the stepwise regression analysis was also carried out for the data obtained to test the significance of the independent variables affecting the root yield as a dependent variable.

Results and discussion

Minerals content

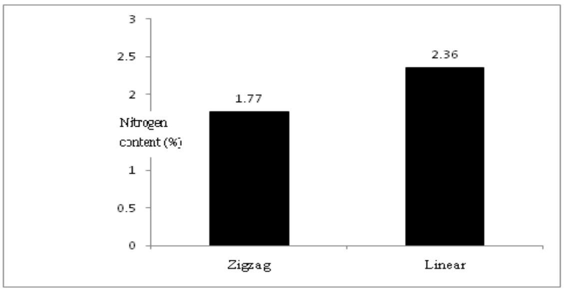
Mean comparisons revealed that in emergence and presence of 12 weed plants per meter row of sugar beet, sodium content in crop roots extract was 3.03%, but only 1.62% from weed free plots. In this experiment increasing of weed density caused to higher sodium concentration in roots (Figure 1). Variations of the concentration of several elements (N, P, K, Ca, Mg, Na, Zn, Cu, Fe, Mn, B, Mo) in the four types of sugar beet collected 94, 114, 134 and 157 days after sowing were evaluated. These kinds of minerals could affect yield quality of the crop. Based on mean comparisons, we understood that planting pattern of Zigzag may increase nitrogen content of sugar beet roots significantly up to 2.36% (Figure 2).

Increasing of plant density in the above mentioned planting pattern lead to higher nitrogen concentration in roots. This result was in agreement with the findings of those field studies conducted in Powell, WY, in 2006 and 2007 to determine the influence of season-long interference of various Venice mallow densities and duration of interference on sugar beet (Dennis *et al.*, 2009).



Weed density (plants per meter row)

Fig. 1. Effect of redroot pigweed density on sodium content of sugar beet root.



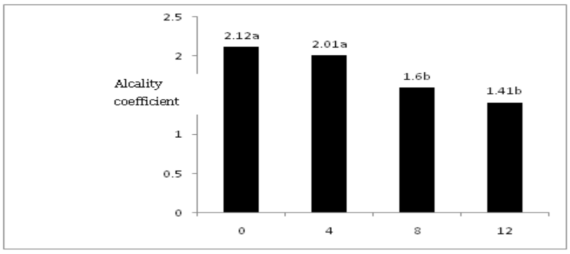
Planting pattern

Fig. 2. Effect of planting pattern on nitrogen content of sugar beet root.

The alcality value in weed free plots and also in plots with 4 weed plants per meter row of sugar beet was higher than 2 (Figure 3). Pietruszewski (2012) in a study on sugar beet reported that the alcality coefficient was higher than 1.8, which from the technological point of view is very advantageous.

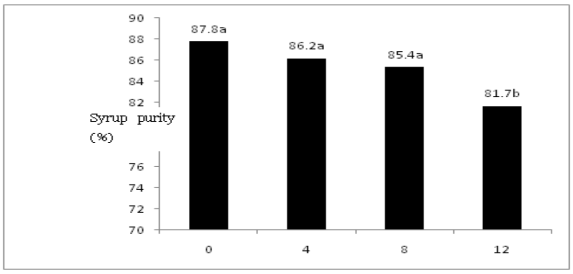
Syrup purity

In lower weedy plots syrup purity in roots improved significantly. Therefore, the highest syrup purity obtained from season long weed free plots (87.8%). The lower purity was also devoted to 12 redroot pigweed plants per meter row of sugar beet (Figure 4). Mean comparisons indicated that planting pattern of Zigzag could increase molasse sugar concentration of sugar beet roots significantly up to 2.44%, and Zigzag pattern experienced 12.7% reduction in molasse sugar compared to linear pattern (Figure 5).



Weed density (plants per meter row)

Fig. 3. Effect of redroot pigweed density on alcality coefficient of sugar beet root.

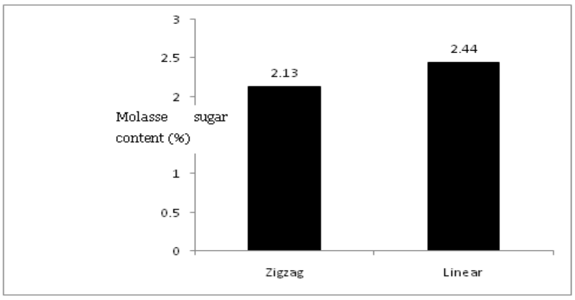


Weed density (plants per meter row)

Fig. 4. Effect of redroot pigweed density on syrup purity of sugar beet root.

Yield traits

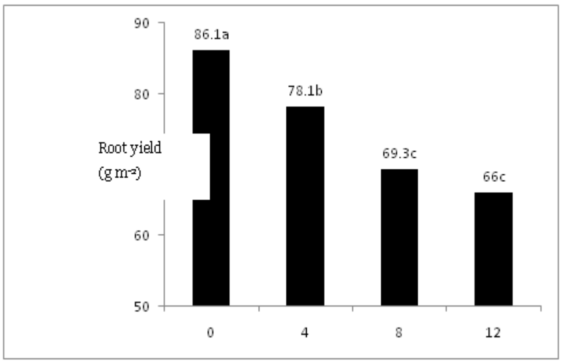
Competition from uncontrolled annual weeds can reduce yield loss (Hartzler *et al.*, 2004). Our results are in good agreement with those reports by Mirshekari *et al.* (2010) on sugar beet. Root yield in full-season interference of 12 weed plants per meter row was 66 kg per hectare when each weed plant removed in plots (Figure 6).



Planting pattern

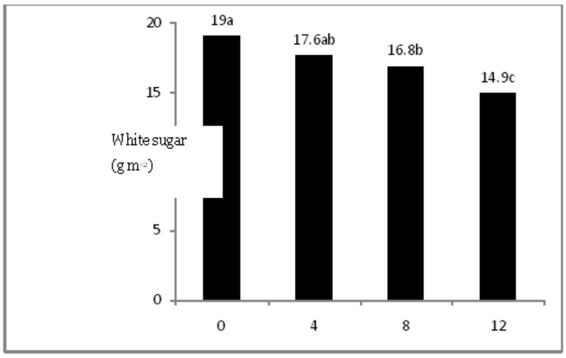
Fig. 5. Effect of planting pattern on molasse sugar content of sugar beet root.

White sugar yield was higher in non weedy plots. In Tranel *et al.* (2003) study, in those treatments with lower weeds biomass, crop biologic yield and yield was in advance. Also, Saberi *et al.* (2007) resulted that with increasing of weed density, sunflower yield and its components reduced, statistically. Root and sucrose yield decreased with increasing red stem filaree density. Sugar beet root yield decreased as the duration of red stem filaree interference increased. White sugar yield in plots with 12 weed plants per meter row of sugar beet reduced 21%, compared to the control (Figure 7). It seems that redroot pigweed had a good competitive power especially in higher densities in sugar beet field. Root and sucrose yield loss per hectare increased as wild buckwheat density increased. The estimated percent yield loss as wild buckwheat density approaches infinity was 64 and 61% for root and sucrose yield loss, respectively. The estimated percent yield loss per unit weed density at low weed densities was 6% for both root and sucrose yield loss (Dennis *et al.*, 2009).



Weed density (plants per meter row)

Fig. 6. Effect of redroot pigweed density on root yield of sugar beet.



Weed density (plants per meter row)

Fig. 7. Effect of redroot pigweed density on sugar yield of sugar beet.

Multiple regression equation

$$\text{Root yield (kg ha}^{-1}) = 0.333 + 0.011 (X_1) + 0.001 (X_2) + 0.040 (X_3) + 0.013 (X_4) + 0.005 (X_5)$$

Resulted stepwise regression equation

$$\text{Root yield} = 2.28 + 0.016 (X_1) + 0.042 (X_2) + 0.042 (X_5);\ R^2 = 0.79$$

Conclusion

The stepwise regression analysis verified that the percentage of sodium and nitrogen in root, and molasse sugar content had a marked increasing effect on the root yield of sugar beet.

References

Dennis CO, Abdel O, Mesbah SD, Miller P, Andrew RK. 2009. Venice Mallow (*Hibiscus trionum*) interference in Sugar beet. Weed Tech **23(4), 581**-585.
http://dx.doi.org/10.1614/WT-09-045.1

Hartzler RG, Battles BA, Nordby D. 2004. Effect of common waterhemp (*Amaranthus rudis*) practice. Weed Sci **52,** 242-245.

Horak MJ, Loughin TM. 2000. Growth analysis of four *Amaranthus* species. Weed Sci **48,** 347-355.

Karimi H. 2003. Iran weed flora. Tehran Univ. Publ., Iran, 420 p.

Knezevic SZ, Weise SF, Swanton CJ. 1994. Interference of redroot pigweed (*Amaranthus retroflexus*) in corn (*Zea mays*). Weed Sci **42,** 568-573.
http://dx.doi.org/10.1614/00431745(2003)051[0202:IORPAR]2.0.CO;2

Mirshekari B. 2008. Efficiency of empirical competition models for simulation of sugar beet (*Beta vulgaris* L.) yield at interference with redroot pigweed (*Amaranthus retroflexus* L.). Iran. J. Sugar beet **24 (2),** 73-91.

Pietruszewski S. 2012. Effect of magnetic field on

yield and chemical composition of sugar beet roots. J Agrophysic **26,** 133-137.
http://dx.doi.org/10.1351/PAC-CON-08-10-18

Saberi A, Mazaheri D, Heydari Sarifabad H. 2007. Study effect of planting pattern and density on physiological parameters and biomass accumulation in maize (*Zea mays* cv. 647). J. Agric. Sci. Nat. Res **13,** 136-146.

Tranel T, Weaver TS, Milberg P. 2003. Interference by the weed *Parthenium hysterophorus* L. with grain sorghum: Influence of weed density and duration of competition. Int. J. Pest Manag **48(3),** 183-188.
http://dx.doi.org/101080/09670870110101739