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Sugar beet (*Beta vulgaris* L.) response to herbicide tank-mixing and Humic acid

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Abstract

To investigate the tank-mixing of herbicides and Humic acid to improve the management of weeds in sugar beet , an experiment was conducted in a randomized complete block design with four replications in private farm located in the village in Khorramabad Jovin in 2012-13. The treatments were as follows: chloridazon at 3.2 Kg ai ha^{-1} mixing with humic acid, phenmedipham at 0.78 Kg ai ha^{-1} mixing with humic acid, desmedipham at 0.54 Kg ai ha^{-1} mixing with humic acid, chloridazon + desmedipham at 1.7 and 0.27 Kg ai ha^{-1} mixing with humic acid, chloridazon + phenmedipham at 1.7 and 0.39 Kg ai ha^{-1} mixing with humic acid, chloridazon + phenmedipham + desmedipham at 1.1, 0.29 and 0.18 Kg ai ha^{-1} mixing with humic acid and weed free and weedy controls. Herbicide was done at 4 to 6 leaf stage of sugar beet. Humic acid with Humax brand name was applied as 4 liters per hectare . The results showed that the highest yield of shoot, root yield and sugar yield was obtained by tank-mixing of chloridazon + phenmedipham with Humic acid. Humic acid application in combination with herbicides was increased Non-sugar percentage, so that the highest levels of gross sugar was obtained when chloridazon and humic acid were mixed. Root impurities was not affected by herbicide mixture but adding humic acid increased the percentage of root impurity. Overall, the results showed that the mixture chloridazon + phenmedipham with Humic acid had highest root yield and sugar yield.

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Introduction

Sugar is one of the most valuable agricultural commodities, produced and consumed around the world. Around 20 % of sugar is derived from sugar beet. Sugar beet is the second major crop for sugar production and nearly seven million hectares of arable land in the world each year is allocated to sugar beet production in 48 countries. Based on available statistics of 2012, the area under cultivation dedicated for this crop has been estimated approximately 4900854 hectares. This area has been 105 thousand hectares for Iran and this product is considered as the main crop within provinces like Razavi Khorasan, West Azerbaijan, Fars and Kermanshah (FAOSTAT 2014).

Herbicides and chemical fertilizers are two main inputs in sugar beet production. Weed is one of the highly important restrictive factors affecting its performance due to long period of growth which diminishes the crop performance. It was reported that Sugar beet is a poor competitor with weeds due to having low canopy in the first year and slow growing early in the season. weeds cause 50-100% losses on Qualitative and quantitative performance of sugar beet.(Irena and Vytautas 2008). Until 2008, 10 herbicide active ingredients were registered in Iran for Broadleaf weeds control in sugar beet (Najafi *et al.* 2013). Increased resistance to herbicides due to single application of herbicide and decreasing of crop spending cuts tends to cause the simultaneous use of herbicides and fertilizers. Applying combined methods to control weeds is one of the ways to decrease herbicide usage. In different integrated weed management methods on weed density and yield of sugar beet crop including Metamitron(Goltix) plus Phenmedipham (Betanal) (Gol+Bet), Goltix plus Cultivation (Gol+Cu), Disk plus Betanal (Di+Bet), Disk plus Cultivation(Di+Cu), Cover Crop plus Betanal (Co+Bet), Cover Crop plus Cultivation(Co+Cu), Weeding (W) and Betanal plus Weeding (Bet+W) (Kouchaki *et al.* 2008) reported that in weeding and application betanal plus weeding treatment compared with other treats weeds had the lowest density. Minimum and maximum sugar beet yield were obtained with cover crop plus betanal and weeding. (Siahmarguee *et al.* 2010) while evaluating different weed management methods in sugar beet fields by treatments including Metamitron+Fenmedifam, Metamitron+Fenmedifam +rotation, Metamitron+Cultivation, Metamitron+Cultivation+rotation, Disk+ fenmedifam, Disk+fenmedifam+rotation, Disk+cultivation, Disk+ cultivation+ rotation, Covercrop+Fenmedifam, Covercrop+Cultivation, Hand-Weeding and Hand-Weeding +Fenmedifam. They showed that Disk+Cultivation and Hand-Weeding + Fenmedifam had the highest and Lowest weed density , respectively. sugar beet yield had different response to management system in two years. In both years, Hand-weeding had the highest root yield but the minimum of root in first year was obtained in cover crop+ Fenmedifam and Metamitron+Fenmedifam had the lowest root yield in second year. Maximum sugar contains in first and second year were obtained in Disk+cultivation and Disk+Fenmedifam. application of chloridazon+phenmedipham at 2.4+0.63 and 3.2+0.78 Kg ai ha^{-1}, phenmedipham+desmedipham+ethofumesate at 0.72 Kg ai ha^{-1} at 4 to 6 leaf stage of sugar beet and triflusulfuron at 10 g ai ha^{-1}at cotyledon leaf stage of sugar beet together with the application of shovel or blade cultivator at 6 to 8 leaf stage of sugar beet repeated at re-emergence of weeds is recommended treatment for weed control in sugar beet field (Ganbari Birgani *et al.* 2007). Many studies have demonstrate good weed control with tank-mixing of herbicide in crop (Abdollahi and Ghadiri 2004).

Nowadays, herbicides and fertilizers especially liquid fertilizers have been combined for joint application with increasing frequency. The combined application of herbicides with fertilizers on allows to save outlays, but may have a negative influence on the growth, development, yielding and qualitative parameters of sugar beet (Domaradzki and Wróbel 2012). the feasibility of joint application of different herbicide with different liquid fertilizer was studied by (Martens *et al.* 1978) . Herbicides were generally

compatible with suspension-grade fertilizers and maintained their phytotoxicity for 24 hours. Atrazine and propachlor were the herbicides most compatible with the liquid fertilizers(Martens *et al*. 1978). (Sarabi *et al*. 2011)indicated that combination of iodosulfuron methyl-sodium plus mesosulfuron-methyl, or plus fenitrotion, or plus librel, and iodosulfuron methyl-sodium plus mesosulfuron-methyl, or plus fenitrotion caused the most reduction in wheat height by 20% and 15%, leaf area by 44% and 39%, leaf fresh weight by 40% and 38%, shoot fresh weight by 36% and 32%, leaf dry weight by 30% and 25% and shoot dry weight by 37% and 29%, respectively. Combination of tribenuron methyl plus clodinafop propargyl, or plus fenitrotion, or plus librel, and tribenuron methyl plus clodinafop propargyl, or plus fenitrotion reduced leaf area, fresh weight and dry weight of wheat plants, but this reduction was not as much as previous mixture. Mixture of two herbicides with librel showed no damaging effect on wheat plants. It was reported that boron and manganese fertilization applied in combination with the herbicide Betanal Elite 274 or separately from the herbicide, improved sugar beet root and leaf yields and raised the sugar content in beet roots(Wróbel and Domaradzki 2013). Domaradzki and Wróbel (2006) have demonstrated that the best timing for a combined application of herbicides and micronutrients could be the last herbicide spraying after sowing, which is usually carried out during the 6–8-leaf growth stage of sugar beetroot (Domaradzki and Wróbel 2006).

Considering that most of herbicides used within sugar beet fields in Iran have common site of action, it's likely that these crops would develop resistance against herbicides. Furthermore, due to highly used herbicides within sugar beet fields with regard to cultivation area within state because of environmental and economic negative effects, it' needed to decide about herbicides application in this regard. Regarding that correct application of herbicides have effects on weed control and inherently on quality and quantity performance of sugar beet, studying to reduce herbicides application rate to investigate herbicides and Humic acid mixture is a necessary issue.

Material and method

This study was performed in randomized complete block design in four replications within a private form located at Khorramabad 36°38'53.6"N 57°36'52.2"E, 60 kms to the north west of Sabzevar in 2013.

The treatments were as follows: chloridazon at 3.2 Kg ai ha^{-1} mixing with humic acid, phenmedipham at 0.78 Kg ai ha^{-1} mixing with humic acid, desmedipham at 0.54 Kg ai ha^{-1} mixing with humic acid, chloridazon + desmedipham at 1.7 and 0.27 Kg ai ha^{-1} mixing with humic acid, chloridazon + phenmedipham at 1.7 and 0.39 Kg ai ha^{-1} mixing with humic acid, chloridazon + phenmedipham + desmedipham at 1.1, 0.29 and 0.18 Kg ai ha^{-1} mixing with humic acid and weed free and weedy controls. Herbicide was done at 4 to 6 leaf stage of sugar beet. Humic acid with Humax brand name was applied as 4 liters per hectare. The land was ploughed in March by Chizer Peeler. Preparation for seed basin bed operations were performed through siclotiller. 300 kg. ha^{-1} of full 20-20-20 fertilizer was added to field soil while seed bed preparation. Cultivation was performed in l9 Feb. 2013 using pneumatic sugar beet seeder machine with 50 cm row space. The field was water immediately after cultivation by leakage method. In order to achieve l0 plant per square meters density we sparse them regulating spaces of rows.

Herbicide were applied as broadcast treatment in water at 400 Lha-1 and 2.5 bar using an Elegance 18 knapsack sprayer(Goizeper S. Cooperative Company, Guipuzcoa, Spain) equipped with a flooding nozzle. Other cultivate treatments were performed based on area tradition and plant needs. Weed number and dry-weight were sampled four week after herbicide application within a fixed 0.5*0.5m(Najafi *et al.* 2013) were calculated within each treatment. At the time of dealing and harvest of sugar beet in region (25 October) after removing of the marginal effect , one cubic mater was harvested completely. After separating of crown and air organic. It took to shoot and root and calculate of root yield and shoot . To

review the quality features of root , samples of root transferred to laboratory of quality analysis of researches and crop services of sugar beet of Khorasan . After collection of all information , analysis of information used by SAS, and drawn tables and charts by Excel. The comparison of informs mean done by method of Duncan.

Results and discussion

Biological yield

Variance Analysis results showed that the way of herbicide mixture has a significant effect on biological yield. The highest biological yield was obtained within treatment by mixture of chloridazon + phenmedipham mixing with humic acid . No weed control resulted in a significant reduction at biological yield so that this treatment has the lowest biological yield. There were no significant statistic differences between chloridazon+phenmedipham mixing with humic acid, chloridazon+ phenmedipham+desmedipham mixing with humic acid and weed free treatment (Table 2). it seems that high biological yield within chloridazon+phenmedipham mixing with Humic acid and chloridazon+phenmedipham+desmedipham mixing with humic acid treatments due to more proper weed control from one hand, positive effects of Humic acid as a speed increasing fertilizer for plant growth have mentioned that it results in leaf number and leaf area surface in sugar beets to increase and finally results in biological yield to grow up. On the other hand Humic acid application results in leaf surface durability which in tum causes more photosynthesis material to continue surface expanding of plant leaf. Humic acid can have positive effects on plant growth directly. Root and areal growth is driven by Humic acid but has more outstanding effects on the root. It expands root mass and makes root system more efficient. Nitrogen, potassium, calcium, magnesium, and phosphor intake grow up by humic acid. Plant clorous is improved through this acid application which is probably derived from acid Humic ability to preserve soil iron so that it is able to be absorbed and metabolized. This phenomenon can be more effective within alkaline and calcic soils that have generally lack of absorbable iron and organics (Rahiet. al, 1385). Naderiet. al(2002) reported performance rise through Humic acid application due to its positive effects on plants cells metabolism and chlorophyll increase. It was indicated when investigation for Humic acid application effects on yield and yield components that application of 3500 and 4500 gr.ha-1 humic acid increases corn seed yield due to rise up in lead area index and leaf surface durability, seed increase in a cob row and length.

Table 1. physical and chemical features of soil in 30 cm deep in the place of test.

Ph	Electrical Conductivity ds/m	Tissue	Organic carbon	Nitrogen	Phosphorus	Potassium	Manganese	Iron	zinc	copper
			percent		Mg/kg					
8/3	2/82		0/62	0/086	6	379	8/36	4/72	0/42	1/2

Rood yield

Herbicide mixture method on root yield was in significance level of 1%. Like biological yield, maximum root yield was obtained through chloridazon+phenmedipham mixing with Humic acid treatment which has no statistic significant difference with phenmedipham mixing with Humic acid and chloridazon at mixing with Humic acid treatment. Lack of weed control resulted in 43.78% reduction in sugar beet yield(Table 2). Daneshianeaal (1391) reported that the highest yield of sugar bett high percentage in control treatment may be derived from drastic reduction of root growth and increasing impure sugar ratio to root volume. Highest and lowest root yields were produced in weed-free and weedy check plots, respectively(Abdollahi and Ghadiri 2004). Among herbicide treatment evaluated depending on year, in 2001 the highest sugar beet yields were with desmedipham plus phenmedipham plus propaquizafop at 0.46 + 0.46 + 0.1 kg/ha and in

2000with desmedipham plus phenmedipham plus ethofumesate at 0.23 + 0.23 + 0.23 kg/ha.(Abdollahi and Ghadiri 2004)

Impure sugar

In case of herbicides mixtures, combination of chloridazon+ desmedipham mixing with Humic acid had the lowest rate of impure sugar. There was no significant statistic difference among other control and herbicides mixture methods. Comparison of means treatment showed that the use of humic acid in combination with herbicides increased gross sugar percentage. the highest level of Impure sugar after the control treatment belong to chloridazon at mixing with Humic acid. Reduction on root growth and increasing of impure sugar to root volume ratio increased impure sugar in weedy treatment. The lowest impure sugar was achieved in chloridazon+ desmedipham mixing with Humic acid treatment(Table 2). Not affected quality parameters such as sugar content, extractable sugar content, and the contents of Na, K and a-amino N to weed management system in sugar beet was reported by (Kaya and Buzluk 2009).Same result reported by (Abdollahi and Ghadiri 2004) that reported Sucrose content and sugar beet brei characteristics were not affected by the herbicide treatments.

Table 2. Effect of tank-mixing of different herbicide on yielding and qualitative components of sugar beet.

Sugar yield ($t.ha^{-1}$)	sugar purity	Pure sugar (%)	root alkalinity (Meq 100 g^{-1} root)	Potassium (Meq 100 g^{-1} root)	impure sugar (Meq 100 g^{-1} root)	Root yield ($t.ha^{-1}$)	Biological yield ($t.ha^{-1}$)	treatment
7.22 c	87.05 b	15.68 b	3.07 bc	4.87 a	19.48 ab	46.1 d	16.12 d	weed free
10.28 ab	90.35 a	16.92 ab	3.92 a	4.22 e	18.77 ab	60.75 ab	24 ab	chloridazon at mixing with Humic acid
9.05 bc	89.42 a	16.02 b	3.77 a	4.55 bc	17.92 abc	56.5 bc	17.48 cd	desmedipham mixing with Humic acid,
10.52c ab	90 a	17.17 ab	2.9 c	4.87 a	18.44 ab	61.28 ab	18.88 cd	phenmedipham mixing with Humic acid
9.29 bc	90.02 a	17 ab	3.15 bc	4.4 d	18.9 ab	54.65 bc	21.08 bc	chloridazon+phenmedipham+desmedipham
9.18 bc	90.45 a	17.32 ab	3.62 ab	4.6 c	18.73 ab	53 c	19.2 cd	chloridazon+ desmedipham mixing with Humic acid,
9.51bc	8.89 a	16.98 ab	3.4 abc	4.8 ab	16.88 bc	56 bc	20.3 bcd	phenmedipham+desmedipham mixing with humic acid
12.30 a	90.66 a	18.5 a	3.47abc	4.55 cd	16.55 c	66.5 a	26 a	chloridazon+phenmedipham mixing with Humic acid
10.18 ab	89.95 a	17.15 ab	3.5 abc	4.72 abc	18.61 ab	59.4 bc	22 abc	Weedy

Values followed by the same letter within the same columns do not differ significantly at p = 5% based on DMRT.

Potassium percentage

Potassium percentage affected by different kind of herbicides mixture. The highest level of potassium was in case of control treatment and the lowest rate was obtained through mixture of chloridazon at mixing with Humic acid. There are not significant difference among weed free, chloridazon+phenmedipham+desmedipham mixing with humic acid and chloridazon+phenmedipham mixing with Humic acid(Table 2). Potassium rate reduction within herbicide mixture treatment especially with soil-applied herbicides can be attributed to root yield increase within these treatments which results in potassium concentration reduction in the root. Presence of chloridazon within mixture may affect ionic activities and this affects negatively potassium transition and intake and causes to potassium rate reduction in root. There is no significant difference between weed free and weedy regarding potassium concentration in root which can

be attributed to lack of effects coming from presence or absence of weed in potassium intake.

Alkalinity

Variance analysis results indicated that the kind of mixture have significant effects on root alkalinity so that the highest rate of alkalinity was observed with mixture of chloridazon at mixing with Humic acid and the lowest rate with phenmedipham mixing with Humic acid(Table 2) . The difference between potassium and sodium intake within these treatments has resulted in different alkalinity rate though there was no significant difference between treatments considering sodium. But sodium rate within herbicides mixture treatments with chloridazon at mixing with Humic acid was high and nitrogen was low and because these two have effects on the alkalinity therefore it has gone up.

Pure sugar

Different kinds of herbicides mixture have effects on pure sugar. Pure sugar rate reduced as a result of weeds competition so that the lowest rate was observed in weedy treatment though had just significant difference with chloridazon+phenmedipham mixing with Humic acid treatment. Weeds competition with sugar beet reverberations to decrease required photosynthesis materials to store sugar(Table 2). No significant difference with other treatments may also be attributed to this issue that humic acid application resulted in extractable sugar rate reduction and impure sugar increment. Performed studies on competitive effects of weeds on sugar beet have shown that this competition affects mostly sugar beet yield and low rate of sugar is affected by weeds competition (Siahmarguee *et al*. 2010).

Sugar purity

Variance analysis results showed that different mixtures have effects on the sugar purity. The lowest rate of purity was in weedy treatment and the highest chloridazon+phenmedipham mixing with Humic acid. Control treatment had significant difference with others. However, it was observed that pre cultivation application of herbicide mixture combined to others have been resulted in purity increment(Table 2). Impurity reduction within root particularly potassium and harmful nitrogen and even sodium can be considered probable reason for sugar purity increment.it was reported that no significant differentiation of sodium, potassium and α-amonium nitrogen content was stated under the influence of joint or separate application of herbicide protection and microelements fertilization(Domaradzki and Wróbel 2006).

Sugar yield

Variance analysis results showed that different mixtures have effects on the sugar yield. Results showed the lowest Sugar yield in the control treatment and the highest sugar yield was observed in chloridazon+phenmedipham+desmedipham mixing with humic acid. No significant difference was found between herbicides treatments. Due to the fact that this part of yield is product of root yield multiplied to sugar rate, it follows root yield and because the lowest and the highest root yields were observed in weedy and chloridazon+phenmedipham mixing with Humic acid treatment respectively, the sugar yield within these two was the lowest and the highest respectively(Table 2). 46% losses in root yield and 48% reduction for sugar yield when weeds were not controlled at all was reported by (Kaya and Buzluk 2009)

Reference

Abdollahi F, Ghadiri H. 2004. Effect of Separate and Combined Applications of Herbicides on Weed Control and Yield of Sugar Beet . Weed technology **18,** 968-976.
http://dx.doi.org/101614/WT-03-142R2

Domaradzki K, Wróbel S. 2006. Possibility of joint application of herbicide protection and trace element fertilization in sugar beet cultivation. Zesz. Probl. Post. Nauk Rol. **508,** 47-53.

Domaradzki K, Wróbel S. 2012. Influence of combined herbicide protection and microelements

fertilization to yield parameters of sugar beet roots. Progress in Plant Protection **52,** 1147-1150.

FAOSTAT. 2014. Agricultural Data. Food and Agricultural Organization of the United Nations. (5.29 2014). http://faostat3.fao.org/faostatgateway/go/to/download/Q/QC/E).

Ganbari Birgani D, Hosseinpour M, Shimi P, Abdollahian Noghabi M. 2007. Integrated weed control of sugar beet in Dezful and Boroujerd. . Iranian Journal of Crop Sciences **8,** 283-299.

Irena D, Vytautas S. 2008. The influence of post-emergence herbicides combinations on broad-leaved weeds in sugar beet. Zemdirbyste-Agriculture **53,** 43-49.

Kaya R, Buzluk Ş. 2009. Integrated weed control in sugar beet through combinations of tractor hoeing and reduced dosages of a herbicide mixture. Turkish journal of agriculture and forestry **30,** 137-144.

Kouchaki AR, Nasiri Mahalati M, Siahmargouei A, Gharakhlou J, Rastgou M, Ghaemi A. 2008. Effect of different integrated weed management methods on weed density and yield of sugar beet crop. Iranian journal of field crops research **6,** 383-391.

Martens A, Burnside O, Cramer G. 1978. Compatibility and phytotoxicity of herbicide-fertilizer combinations. Agronomy Journal **70,** 1089-1098. http://dx.doi.org/10.2134/agronj1978.00021962007000060047x

Najafi H, Bazoubandi M, Jafarzadeh N. 2013. Effectiveness of Repeated Reduced Rates of Selective Broadleaf Herbicides for Postemergence Weed Control in Sugar Beet (*Beta vulgaris*). World Journal of Agricultural Research **1,** 25-29. http://dx.doi.org/10.12691/wjar-1-2-1

Sarabi V, Mousavi SK, Rashed Mohassel MH. 2011. Effects of iodosulfuron methyl-sodium plus mesosulfuron-methyl and tribenuron methyl plus clodinafop propargyl mixed by fenitrotion and librel bmx micronutrient solution on wheat growth. Iranian Journal of Field Crops Research **9,** 114-121.

Siahmarguee A, Koocheki AR, Nassiri Mahallati M. 2010. Effect of different integrated weed management methods on weed characteristics and yield of sugar beet. Electronic Journal of Crop Production **3,** 49-71.

Wróbel S, Domaradzki K. 2013. Combined foliar application of boron and manganese with herbicide in sugar beet cultivation. Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu - Rolnictwo **105,** 71-80.