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ORIGINAL PAPER

Effect of the introducing of herbicide combinations on the yield of sunflower hybrid Kaliya

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Abstract

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The investigations were carried out during 2016–2017 at Dobrudzha Agricultural Institute – General Toshevo (DAI). The aim of this investigation was to determine the effect of the introducing of herbicide combinations on the yield in sunflower hybrid ”Kaliya”. The following herbicides combinations were used: pendimetalin (450 ml) + linuron (300 ml); linuron (300 ml) + pendimetalin (450 ml); metolachlor + terbutilazin (350 ml) + kletodim (160 ml); petoxamide (300 ml) + linuron (300 ml). The herbicides were applied at stage 01 (BBCH), and pendimetalin (450 ml) and kletodim (160 ml) at stage 12-14 (BBCH) on sunflower hybrid **”Kaliya”**. The herbicide effect was determined by the quantitative weight method and evaluated by the EWRS scale. These were the followed parameters: plant height (cm), head diameter (cm), weight of seeds per plant (g), weight of 1000 seeds (g) and oil content of seed (%). In 2016, highest yield was realized in the variant with petoxamide (300 ml) + linuron (300 ml). The decrease of yield according to the untreated check variant was lowest – with 8.8%. In 2017, metolachlor + terbutilazin (350 ml) + kletodim (160 ml) was the variant with highest yield and lowest decrease of yield – with 10.6%. %. The interaction between the factors years and herbicides (YxH) was with the highest strength of effect on parameters yield, oil content of seeds and plant height (55-72%). Significantly lower was the effect of the factors years and applied herbicide. Meteorological conditions of the year as a factor do not effect on the indicator plant height. The interaction between the factors years and herbicides

(YxH) was with the highest strength of effect on parameters weight of seeds per plant (91%) and weight of 1000 seeds (55%). Significantly lower was the effect of the factors years and applied herbicide. Meteorological conditions were with the highest strength of effect on parameter head diameter (89%).

Key words: Sunflower, Herbicides, Weeds, Yield, Structural elements of yield

Introduction

Sunflower (*Helianthus annuus L.*) is sensitive to weed infestation. Weed interference can reduce seed yield of sunflower, with level of yield loss varying among weed species (Wanjari et al., 2001). Weed control in sunflowers is one of the most critical elements in a management system that optimized yield and quality. Sunflowers are planted at law densities and develop slowly during the initial weeks after planting. Weed competition with sunflowers during the first four weeks after crop emergence from species adapted to cool conditions wild mustard - *Sinapis arvensis L.*, spring wild oats - *Avena fatua L.* can reduce sunflower yield by 30%. Once sunflowers become established they compete more effectively with weeds. Herbicide options for sunflower have expanded, but there is a need for an integrated approach to maintain successful weed management strategies to preserve yield potential. Air temperature, rainfall, as well as wind can significantly effect the action of applied herbicides (Pannacci et al., 2007). Herbicides can cause various damage to sunflower (Blamey et al., 1997). Therefore, timely weed control is important for obtaining optimum yields in sunflower. Having information on the period of germination of the weeds, which is related to the period of emergence of the crop, is an important factor for decision making on weed control (Bosnic and Swanton, 1997). For control of broadleaf weeds in sunflower after sowing and pre-emergence, the following active substances are commonly used: linuron, flurochloridone, oxyfluorfen, pendimethalin, prosulfocarb, bifenox, flumioxazine and lenacil (Pannacci et al., 2007; Nadasy et al., 2008; Kilinc et al., 2011) in combination with acetamide herbicides (acetochlor, dimethenamid, pethoxam, metolachlor, proposchlor), which are applied to control of cereal weeds (Pannacci et al., 2007; Nadasy et al., 2008). Soil herbicides introduced immediately after sowing enhance the efficacy of vegetative herbicides controlling weeds in the sunflower (Lopes Ovejero et al., 2013; Beckie and Hall, 2014). It is known that the efficacy of soil herbicides is significantly influenced by soil moisture. In drought the influence of soil herbicides usually decreases (Zhang et al., 2001; Zanatta et al., 2008).

The aim of this investigation was to determine the effect of the introducing of herbicide combinations on the yield of sunflower hybrid **"Kaliya"**.

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Material and methods

The investigations were carried out during 2016 – 2017 at DAI – General Toshevo. The fired trial was designed according to the block method in three replications, the size of the trial area being 14 m^2 and crop density 5500 plants per da.

Two controls are included: K_1 - control, without weeds manually harvested to sunflower booting stage and the K_2 - weeded control until the end of the crop's vegetation (Table 1).

Table 1. Variants

Variants	Active substance	Doses (ml)
Check without weeds	-	-
Stomp 330EK+Kalin Flo	pendimetalin+linuron	450+300
Kalin Flo+ Stomp 330EK	linuron+pendimetalin	300+450
Gardoprim plus Gold 500SK+Select Super 120EK	metolachlor+terbutilazin+ kletodim	350+160
Sucssesor 600EK+Kalin Flo	petoxamide+linuron	300+300
Weeded check	-	-

The herbicides were applied at stage 01 (BBCH), and pendimetalin (450 ml) and kletodim (160 ml) at stage 12-14 (BBCH) on sunflower hybrid **"Kaliya"**. Relying on natural weed infestation from grassy weeds: green hides - Setaria viridis *L.* and cockspur - Echinochloa crus-galli *L.* and broadleaved weeds: wild mustard - Sinapis arvensis *L.*, thorn-apple - Datura stramonium *L.*, rough cocklebur - Xanthium strumarium L., common amaranth - Amaranths retroflexus *L.*, black-bindweed - Polygonum convolvulus *L.*, fat-hen - Chenopodium album *L.*, water papper - Polygonum hydropiper, field bindweed - Convolvulus arvensis *L.*, creeping thistle - Cirsium arvense (*L.*) Scop and hemp - Canabis sativa *L.* Weed density was measured quantitatively per unit area by species using ¼ frame in four replications prior to introduction of herbicides.

The herbicide efficiency was estimated 25-30 days after the use of the preparations according to species, by amount and weight, using ¼ frame in four replications, measuring the weight of the weeds in fresh and dry condition. The effect was evaluated according to the 9-degree scale of EWRS for reading of the herbicide activity and selectivity, 1 corresponding to 100 % efficiency of the preparation, without symptoms of phytotoxicity on the cultural plants; and 9 corresponding to 29.9 % - 0 % effect of the preparation and complete perishing of the plants (Table 2).

Table 2. Herbicide activity and selectivity according to 9-degree scale of EWRS

Rank	Herbicide effect, %	Damage symptoms	General evaluation
1	100	No symptoms – healthy plants	Excellent
2	99.9-98	Very weak symptoms – slight stunt effect	Very good
3	97.9-95	Weak but discernable symptoms	Good
4	94.9-90	Better expressed symptoms (eg. chlorosis) which do not affect yield	Satisfactory
5	89.9-82	Thinning of the crop, strong chlorosis or stunt. Lower yield expected	Indefinitely
6	81.9-70	Heavy damage or perishing of plants	Unsatisfactory
7	69.9-55		Poor
8	54.9-30		Very poor
9	29.9-0		Extremely poor

Hybrid **"Kaliya"** is designed for oil. Maximum yield seed-288 kg/da and oil yield-116.4 kg/da. The oil content of the seeds is 43.8%. Mass of 1000 seeds-62.2 g. Vegetation period 119 days.

These were the followed parameters: plant height (cm), head diameter (cm), weight of seeds per plant (g), weight of 1000 seeds (g). The parameter oil content of seeds is shown as a persentage (%).

Results and discussion

In 2016 the highest average monthly temperature in July is established (22.8 ^{0}C) (Fig. 1). The vast amount of precipitation (117.1 mm) during the month of May were good for intensive growth and development of the hybrid in the initial stages. The months July and August are dry compared to the multi-annual period. 2017 is characterized also with favorable weather conditions. Monthly temperature is highest during the month of August (22.8 ^{0}C). In June recorded the greatest amount of precipitation (87.7 mm) compared to multi-annual data.

The analysis of the variances for structural elements of yield expressed correlations of the values of the index with the independent and combined effect of the factors tested in the experiment (Table 3).

In 2016, highest yield was realized in the variant with petoxamide (300 ml) + linuron (300 ml). The decrease of yield according to the untreated check variant was lowest – with 8.8%. In 2017, metolachlor + terbutilazin (350 ml) + kletodim (160 ml) was the variant with highest yield and lowest decrease of yield – with

10.6%.

The interaction between the factors years and herbicides (Y x H) was with the highest strength of effect on parameters yield, oil content of seeds and plant height (55-72%). Significantly lower was the effect of the factors years and applied herbicide. Meteorological conditions of the year as a factor do not effect on the indicator plant height (Fig. 2).

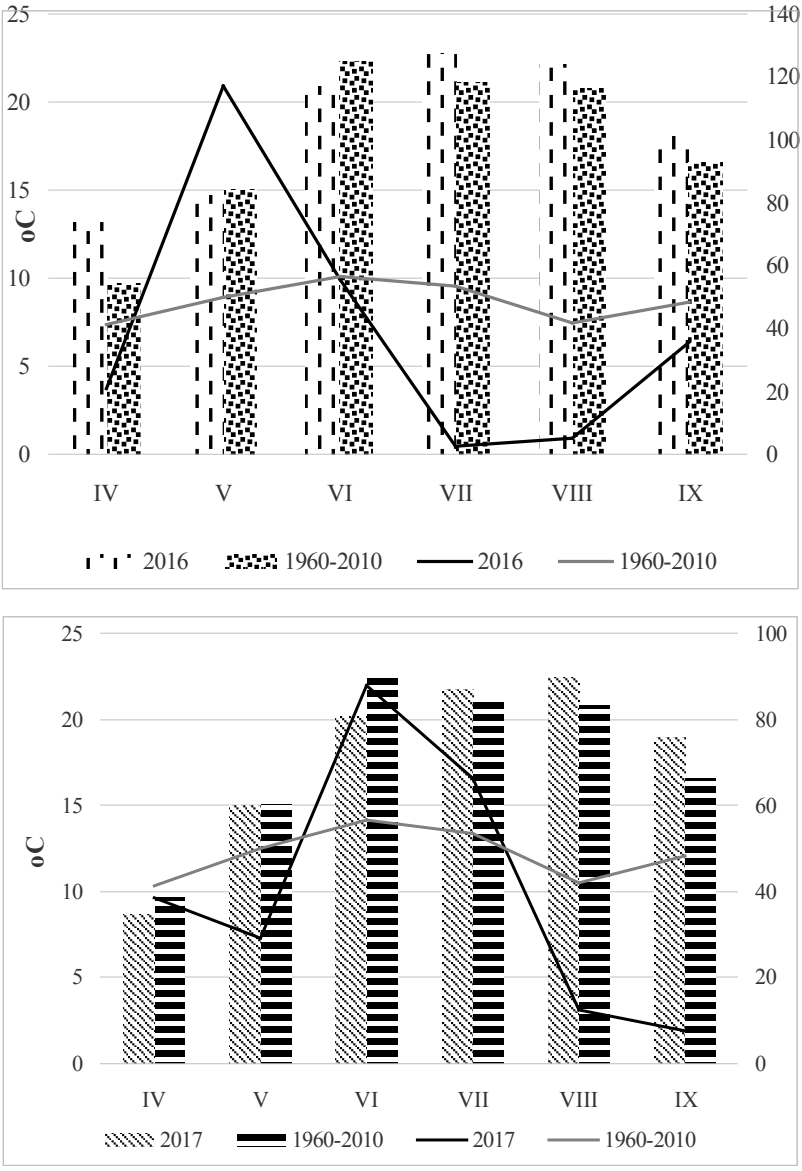

Figure 1. Air temperature and rainfalls during the period 1960-2017

Table 3. Structural elements of productivity-analysis of variances (p - 0,05)

Source	df	Yield		Oil content of seeds		Plant hight		Head diameter		Weight of seeds per plant		Weight of 1000 seeds	
		F	Sig	F	Sig	F	Sig	F	Sig	F	Sig	F	Sig
Years	1	9,275	,006	14,089	,001	,000	1,000	18,623	,000	,142	,710	8,305	,000
Herbicide	3	12,139	,000	25,904	,000	2,222	,112	1,955	,148	,377	,771	10,112	,000
YxH	3	25,889	,000	93,413	,000	5,778	,004	,408	,408	5,227	,006	22,317	,000

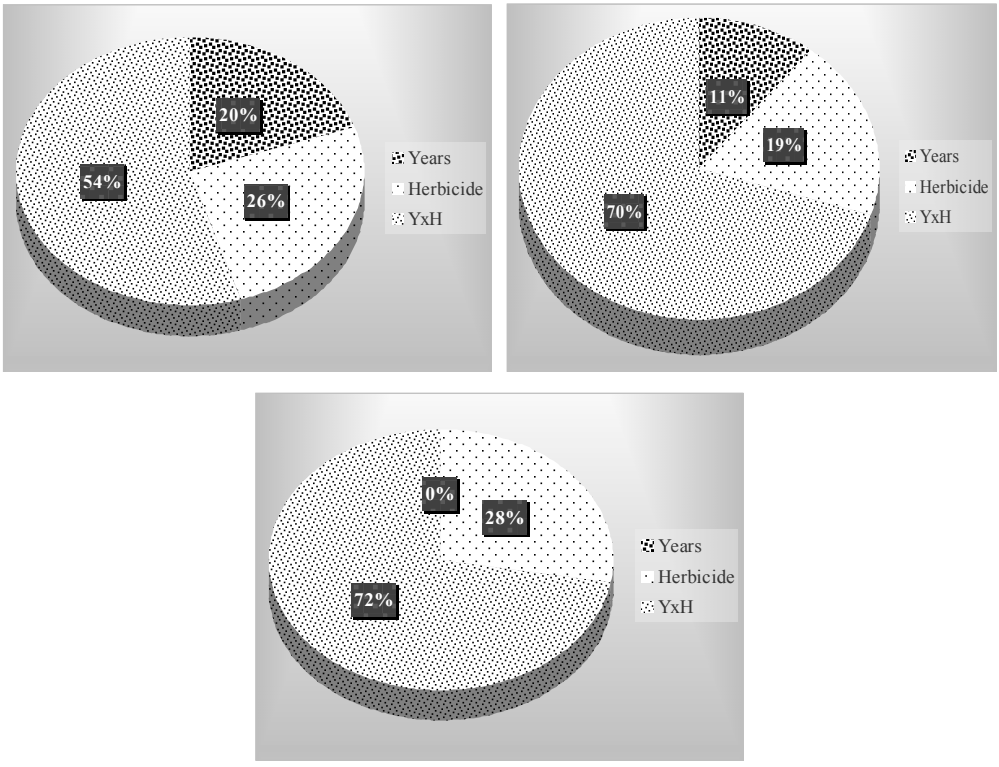

Figure 2. Strength of the factors´ effect on yield, oil content of seeds and plant height

The interaction between the factors years and herbicides (Y x H) was with the highest strength of effect on parameters weight of seeds per plant (91%) and weight of 1000 seeds (55%). Significantly lower was the effect of the factors years and applied herbicide (Fig. 3). Meteorological conditions were with the highest strength of effect on parameter head diameter (89%).

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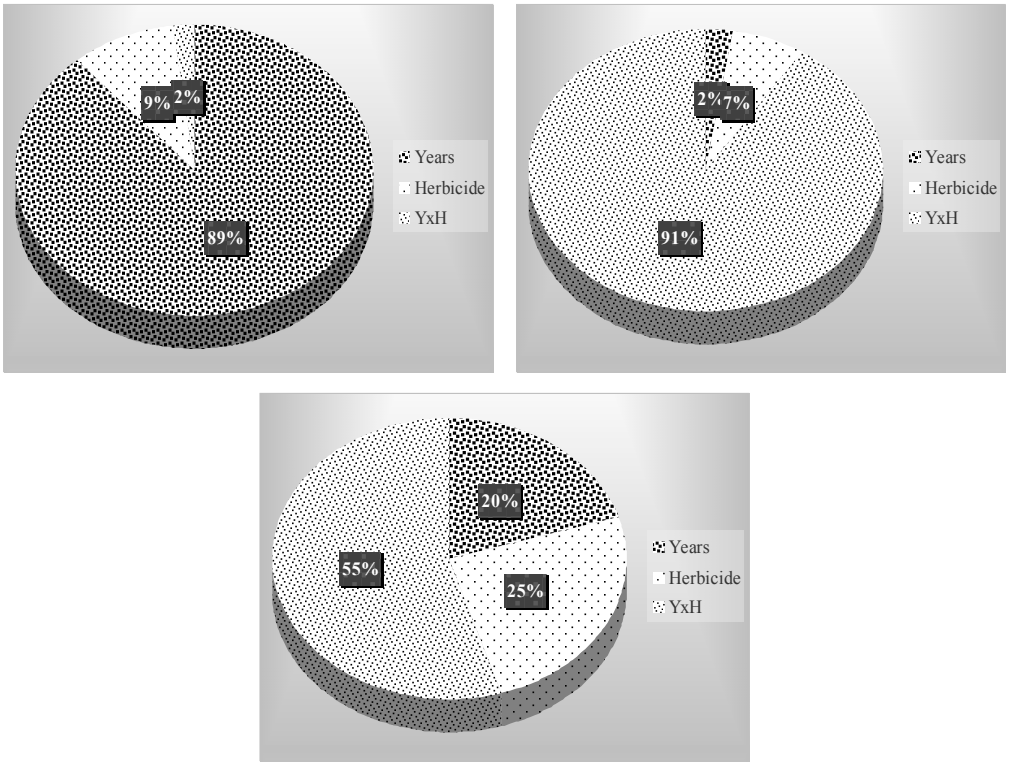

Figure 3. Strength of the factors´ effect on head diameter, weight of seeds per plant and 1000 seeds weight

Conclusions

1. In 2016, highest yield was realized in the variant with petoxamide (300 ml) + linuron (300 ml). The decrease of yield according to the untreated check variant was lowest – with 8.8%. In 2017, metolachlor + terbutilazin (350 ml) + kletodim (160 ml) was the variant with highest yield and lowest decrease of yield – with 10.6%.

2. The interaction between the factors years and herbicides (Y x H) was with the highest strength of effect on parameters yield, oil content of seeds and plant height (55-72%). Significantly lower was the effect of the factors years and applied herbicide. Meteorological conditions of the year as a factor do not effect on the indicator plant height.

3. The interaction between the factors years and herbicides (Y x H) was with the highest strength of effect on parameters weight of seeds per plant (91%) and weight of 1000 seeds (55%). Significantly lower was the effect of the factors years and applied herbicide. Meteorological conditions were with the highest strength of effect on parameter head diameter (89%).

References

Beckie, H.J. & Hall, L.M. (2014). Genetically-modified herbicide resistant crops a two-edged sword? An Americans perspective on development and effect on weed management. *Crop protection*, 66: 40-45.

Blamey, F.P., Zollinger, R. & Schneiter, A. (1997). Sunflower production and culture. In: A. A. Schneiter (Ed.), Sunflower Technology and Production, Agronomy Monograph 35. ASA, pp. 595-670.

Bosnic, A.C., & Swanton, C.J. (1997). Influence of barnyard grass (*Echinochloa cruss-galli*) time of emergence and density of corn (*Zea mays*).*Weed Science*, 45: 276-282.

Kilinc, O., Grassrt, R. & Reynaud, S. (2011). The herbicide aclonifen: The complex theoretical bases of sunflower tolerance. *Pesticide Biochemistry and Physiology*, 100: 193-198.

Lopes Ovejero, R.F., Soares, D.J., Oliveira, W.S., Fonseca, L.B., Berger, G.U., Soteres, J.K. & Christoffoleti, P.J. (2013). Residual herbicides in weed management for glifozate-resistant soybean in Brazil. *Planta Daninha*, 31: 947-959.

Nadasy, E., Nadasy, M. & Nagy, V. (2008). Effect of soil herbicides on development of sunflower hybrid. *Cereal Research Communications*, 36: 847-850.

Pannacci, E., Graziani, F. & Covarelli, G. (2007). Use of herbicide mixtures for pre and post-emergence weed control in sunflower (*Helianthus annuus* L.). *Crop Protection*, 26: 1150-1157.

Vargas, D., Sganzwerla, C., Rosenthal M.D. & Pinto, J.J.O. (2008). Soil water contents and fomesafen efficacy in controlling *Amaranthus hybridus*. *Planta Daninha*, 26:143-155.

Wanjari, R.H., Yaduraju, N.T. & Ahuja, K.N. (2001). Crirtical period of crop-weed competition in rainy season sunflower (*Helianthus annuus* L.). *Indian Journal of Agronomy*, 46: 309-313.

Zanatta, J.F., Procopio, S.O., Manica, R., Pauletro, E.A., Cargnelutti, F.A., Vargas, L., Sganzwerla, D.C., Rosenthal, M.D. & Pinto, J.J.O. (2008). Soil water contents and fomesafen efficacy in controlling *Amaranthus hybridus*. *Planta Daninha*, 26:143-155.

Zhang, W., Webster, E.P. & Selim, H.M. (2001). Effect of soil moisture on efficacy of imazethapyr in greenhouse. *Weed Technology*, 15: 355-359.