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THE EFFECT OF TILLAGE SYSTEMS AND WEED CONTROL ON THE YIELD OF YELLOW LUPINE (*Lupinus luteus* L.)

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ABSTRACT

Background. Reduced tillage systems enable a reduction in expenditure on energy and improve the economic effectiveness of production, but, among other things, they are favourable for weed infestation of a plantation. The aim of the study was to determine the effect of tillage systems and methods of treatment on the reduction in weed matter, and to determine the phytotoxic effect of herbicides applied on the damage of plants of yellow lupine and its yield.

Material and methods. The study results come from a field experiment set up in a split-plot design in three replications. The studied factors included: I – two tillage systems – conventional and reduced: II – five methods of weed control: 1) control plot – mechanical treatment, 2) chemical treatment – spraying with preparation Afalon Dyspersyjny 450 SC (linuron) directly after sowing, 3) mechanical and chemical treatment [Metron 700 SL (metamitron)], 4) chemical treatment Afalon Dyspersyjny 450 SC + Metron 700 SL, 5) chemical treatment Afalon Dyspersyjny 450 SC + Metron 700 SL + Fusilade Forte 150 EC (fluazifop-p-butyl).

Results. The assessment of weed infestation was carried out two weeks after applying the last herbicide treatment as well as directly before harvesting the yellow lupine seeds. The air dry mass of weeds was lower after conventional tillage than after reduced tillage. The lowest quantity of weeds was recorded after applying conventional tillage and three herbicides, and the highest quantity was on the control plot. The highest plant damage was observed after applying three herbicides. The seed yield of yellow lupine was significantly modified by tillage systems, methods of weed control and weather conditions occurring in particular growing seasons.

Conclusion. Weed control on plots with herbicide treatment contributed to an increase in the seed yield of yellow lupine compared with the control plot. Moreover, response to herbicide damages in yellow lupine significantly depended on the applied cultivation methods, causing slight damages to disappear with the passing time.

Key words: herbicides, mechanical treatment, phytotoxicity, reduced tillage, seed yield, selectivity

INTRODUCTION

Reduced tillage systems have been gaining more and more supporters due to the benefits resulting from reducing energy expenditure on tillage, and to an improvement in the economic effectiveness of production. However, omitting ploughing is accompanied by a higher accumulation of weed seeds in the topsoil (Faligowska and Szukała, 2008).

Fabaceae plants react really badly to weed infestation. This is connected with their slow rate of development in the first 4-6 weeks after emergence, and

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thus with having a very low ability to compete with weeds. Weed infestation of a plantation is mainly affected by environmental and agronomic factors. Agronomic methods of weed control are not always fully effective. Therefore, most planters choose a chemical method with the use of synthetic herbicides (Podleśny *et al.*, 1993, Borówczak *et al.*, 2008).

Reducing weed infestation in yellow lupine is still a relatively major problem for agricultural practice, as at present, according to the Recommendations for Plant Protection (2014), there are only two registered preparations: herbicide Afalon Dyspersyjny 450 SC and graminicide Fusilade Forte 150 EC.

In this paper a research hypothesis was assumed both that tillage systems and cultivation treatments with the use of herbicides and their combinations may to various extents affect the effectiveness of weed control as well as the phytotoxic effect of herbicides on yellow lupine plants. Moreover, in the cultivation of yellow lupine, there is a highly limited number of herbicides that can be applied for the control of weeds, especially for the dicotyledonous ones. Therefore, the aim of the undertaken study was to determine the effect of tillage and treatment methods on reducing weed mass and to determine the phytotoxic effect of the used herbicides on yellow lupine plants and their yield.

MATERIAL AND METHODS

Research results come from a field experiment carried out in 2008-2010 on an Experimental Farm in Zawady (52°03'N: 22°33'E), property of the Siedlce University of Natural Sciences and Humanities. The experiment was set up as a two-way experiment in a split-plot design in three replications. The studied factors were:

I – two tillage systems: 1) conventional tillage (skimming unit + set of post-harvest soil treatments, pre-winter ploughing, dragging in spring, and cultivator unit right before sowing), 2) reduced tillage (skimming unit 2x, cultivator unit in spring right before sowing)

II – five methods of weed control: 1) control plot – mechanical treatment (from sowing to emergence harrowing once, after emergence harrowing twice until the plants have reached a height of 5 cm), 2) chemical treatment – directly after sowing, spraying with the herbicide Afalon Dyspersyjny 450 SC at a rate of 1.5 $dm^3 \cdot ha^{-1}$ (active substance: linuron – 675 $g \cdot ha^{-1}$), 3) mechanical and chemical treatment (until emergence harrowing once, after emergence harrowing twice until plants have reached a height of 5 cm, next spraying with the herbicide Metron 700 SL at a rate of 4.0 $dm^3 \cdot ha^{-1}$ (active substance: metamitron – 2800 $g \cdot ha^{-1}$), 4) chemical treatment – directly after sowing, spraying with the preparation Afalon Dyspersyjny 450 SC at a rate of 1.5 $dm^3 \cdot ha^{-1}$ (active substance: linuron – 675 $g \cdot ha^{-1}$), after plants have reached a height of 5 cm spraying with the preparation Metron 700 SL at a rate of 4.0 $dm^3 \cdot ha^{-1}$ (active substance: metamitron – 2800 $g \cdot ha^{-1}$), 5) chemical treatment – directly after sowing, spraying with the herbicide Afalon Dyspersyjny 450 SC at rate of 1.5 $dm^3 \cdot ha^{-1}$ (active substance: linuron – 675 $g \cdot ha^{-1}$), next after plants have reached a height of 5 cm spraying with preparations: Metron 700 SL at a rate of 4.0 $dm^3 \cdot ha^{-1}$ (active substance: metamitron – 2800 $g \cdot ha^{-1}$) + Fusilade Forte 150 EC at a rate of 1.5 $dm^3 \cdot ha^{-1}$ (active substance: fluazifop-p-butyl 225 $g \cdot ha^{-1}$).

The field experiment involved cultivation of cv. Taper which is a self-completing cultivar without lateral branches that has a strongly determined vegetation and very early maturation. It is intended for cultivation for seeds throughout Poland. At the same time it is tolerant to infections caused by fungi from the genus *Fusarium* sp. According to breeder's (Poznańska Hodowla Roślin) declaration this cultivar's 1000 seed weight is 130-140 g, protein content 40.0-41.0%, and it produces a high yield of seeds.. The field experiment was set up on a sandy lessive soil, bonitation class IVa and IVb, in terms of agricultural suitability it is included in the very good rye complex (Marcinek and Komisarek, 2011).

The content of organic matter in particular years of the research was in 2008 – 13.7 $g \cdot kg^{-1}$, 2009 – 14.1 $g \cdot kg^{-1}$, 2010 13.5 $g \cdot kg^{-1}$, while soil reaction ranged from pH 5.0 to pH 5.3. The forecrop in all three growing seasons was winter triticale. Spraying was carried out with an approved sprayer that is appropriate for conducting such treatments, in accordance with the instructions for application on the product's label.

Analysis of weed infestation was carried out on an area of 1 m^2 with the quantity-weight method on two dates, i.e. two weeks after applying the last herbicide treatment, and directly before harvesting the yellow lupine seeds. The range of occurrence of phytotoxic damage in lupine was determined according to the 9-degree bonitation scale of the European Weed Research Council (EWRC) (where: 1 – no signs of effect, 9 – total plant damage) two weeks after conducting the last spraying treatment (Domaradzki *et al.*, 2001). The harvest was carried out at the stage of full seed maturity (BBCH 89) (Adamczewski and Matysiak, 2005). The yield was calculated based on the weight of seeds harvested from a plot with an area of 15 m^2, and is presented as the total yield in tons per 1 hectare.

The research results were elaborated statistically with the use of the analysis of variance. Significance of the sources of variation was examined with the F-test, while the assessment of the significance of differences, with the level of significance being p = 0.05, between the compared means was with the use of Tukey's range test (Trętowski and Wójcik, 1991).

Weather conditions in the years of research are presented in Table 1. The highest amount of rainfall was observed in the growing season of 2010 – 349.8 mm, while the lowest amount was in 2008 – 308.0 mm, however, its distribution and total in particular months was similar to the long-term mean and it was the year that was most favourable for the growth and development of lupine. In 2009 the weather conditions in particular months of vegetation were diversified, and according to Sielianinov's coefficient they ranged from a severe drought in April and July to an excess of moisture in June. This was the year that was least favourable for the lupine yield.

Table 1. Characteristic of weather conditions in 2008-2010 (Zawady Meteorological Station)

Year	Month					
	April	May	June	July	August	April-August
	Rainfall, mm					Sum
2008	28.2	85.6	49.0	69.8	75.4	308.0
2009	8.1	68.9	145.2	26.4	80.9	329.5
2010	10.7	93.2	62.6	77.0	106.3	349.8
1987- 2000	38.6	44.1	52.4	49.8	43.0	227.9
	Temperature, °C					Mean
2008	9.1	12.7	17.4	18.4	18.5	15.2
2009	10.3	12.9	15.7	19.4	17.7	15.2
2010	8.9	14.0	17.4	21.6	19.8	16.3
1987- 2000	7.8	12.5	17.2	19.2	18.5	15.0
	Sielianinov's hydrothermic coefficients*					Mean
2008	1.04	2.18	0.94	1.25	1.36	1.35
2009	0.26	1.72	3.08	0.44	1.48	1.40
2010	0.40	2.14	1.20	1.15	1.74	1.33

* Value of coefficients Sielianinov (Bac i in., 1998)
< 0,5 strong mild drought; 0,51-0,69 mild; 0,70-0,99 weak mild drought; ≥ 1 fault drought

RESULTS AND DISCUSSION

From the conducted analyses it follows that the predominant weed species were: *Chenopodium album* L., *Echinochloa crus-galli* L, *Capsella bursa pastoris* L. as well as *Avena fatua* L. To a lesser extent there occurred: *Fallopia convolvulus* L., *Agropyron repens* L. and *Cirsium arvense* L. These results are in line with the studies of Głowacka (2013), who indicated that *Chenopodium album* L., *Echinochloa crus-galli* L., and *Galinsoga parviflora* L. were the predominant species in stands of lupine, maize and oats. This authoress indicated that their proportion constituted from 34.1% to 99% of the total number of weeds.

Statistical analysis indicated the significant effect of tillage systems, methods of weed control and weather conditions occurring in particular years of the research on the quantity of the air dry mass of weeds in yellow lupine cultivation (Tables 2, 3). Tillage methods used in the experiment had a significant effect on the value of the air dry mass of weeds determined on all of the weed collection dates during the studies. The dry mass of weeds determined on the first date of research (two weeks after carrying out the last treatment) was lower on plots with conventional tillage, and was on average 56.3 g·m^{-2}, while on plots with reduced tillage it was 75.1 g·m^{-2}. However, on the second date of assessment (before harvesting seeds), the air dry mass of weeds on plots with conventional tillage was 217.4 g·m^{-2}, and was on average 65.8 g·m^{-2} lower when compared to the plots with reduced tillage. The results obtained in the conducted studies are similar to the studies of Holka and Faligowska (2010), who found the lowest air dry mass of weeds on the plots with conventional tillage, while the highest mass was in the case of using reduced tillage. Furthermore, in his studies Piekarczyk (2006) showed that abandoning post-harvest tillage contributed to an increase in the total number and weight of weeds by 64.1 and 49.4%, respectively, compared with conventional post-harvest tillage.

However, different research results were obtained by Faligowska and Szukała (2008). According to these authors, the dry mass of weeds in both the plough tillage and no-tillage system was higher by 50% than in the reduced tillage system. On the other hand, Blecharczyk *et al.* (2011) indicated that fresh matter of weeds was the lowest on plots with shallow ploughing.

The results obtained in our studies confirmed previous reports of other authors (Głowacka, 2013; Abd El Wahed *et al.*, 2015), that methods of weed control significantly reduced the quantity of the air dry mass of weeds (Tables 2, 3), however, their effect was diversified depending on the active substances applied. After analysing the effects of particular herbicides on weed infestation we can state that the active substance metamitron used in Metron 700 SL reduced the air dry mass of weeds more effectively in comparison to the linuron contained in Afalon Dyspersyjny, on average by 32.9 g·m^{-2}. The lowest quantity of air dry mass of weeds per unit of area determined was obtained with the herbicide combination: Afalon Dyspersyjny 450 SC + Metron 700 SL + Fusilade Forte 150 EC, and it was on average 16.5 g·m^{-2} and 156.8 g·m^{-2}, respectively in the first and second collection dates (Tables 2, 3). The highest dry mass of weeds was found on the control plot for each collection date and was on average 131.3) and 414.3 g·m^{-2}, respectively.

Głowacka (2013) found that chemical methods of weed control significantly decreased both the number and weight of weeds compared with mechanical method. Also, Abd El Wahed *et al.* (2015) in their studies indicated that using fluazifop-p-butyl causes a reduction in weed infestation with monocotyledonous species in lupine cultivation.

We observed no interaction between tillage systems and methods of weed control.

According to Faligowska and Szukała (2008) as well as Gugała and Zarzecka (2012), diversified humidity and thermal conditions in particular growing seasons have a significant effect on weed infestation in lupine plantations. In the conducted research it was indicated that both the amount of rainfall and its distribution affected the weed mass (Tables 2, 3). The highest weed infestation determined on the first date, on average 82.6 g·m^{-2}, was observed in 2008, when at the beginning of vegetation in April and May there occurred intensive rainfall at the level of 28.2 and 85.6 mm. However, before harvesting the seeds, the highest weed infestation was observed in 2010, when at the end of vegetation the highest rainfall was observed as well as the highest mean air temperature.

Table 2. Air-dry weight of weeds, $g \cdot m^{-2}$ (first date of observation)

Weed control methods	Tillage systems		Year			Mean
	conventional	reduced	2008	2009	2010	
Control – Harrowing 3x	105.2	157.5	159.1	110.2	124.7	131.3
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$	75.7	107.4	104.5	83.8	86.3	91.5
Harrowing 3x + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	61.7	63.5	71.9	57.2	58.7	62.6
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	24.5	28.5	48.3	15.4	15.9	26.5
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL(metamitron) – 4,0 $dm^3 \cdot ha^{-1}$ + Fusilade Forte 150 EC (fluazyfop-P butylu) – 1,5 $dm^3 \cdot ha^{-1}$	14.3	18.7	29.1	9.8	10.7	16.5
Mean	56.3	75.1	82.6	55.3	59.3	–

$LSD_{0,05}$ for:
years 2.5 tillage systems 1.9 weed control methods 3.8
interaction
tillage systems × weed control methods ns
years × weed control methods ns

Table 3. Air-dry weight of weeds, $g \cdot m^{-2}$ (second date of observation)

Weed control methods	Tillage systems		Year			Mean
	conventional	reduced	2008	2009	2010	
Control – Harrowing 3x	342.3	486.3	364.6	427.6	450.8	414.3
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$	236.6	286.8	203.8	240.9	340.5	261.7
Harrowing 3x + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	211.4	246.2	194.0	195.6	296.9	228.8
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	171.1	208.4	162.8	186.3	220.2	189.7
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL(metamitron) – 4,0 $dm^3 \cdot ha^{-1}$ + Fusilade Forte 150 EC (fluazyfop-P butylu) – 1,5 $dm^3 \cdot ha^{-1}$	125.6	188.0	140.0	157.2	173.3	156.8
Mean	217.4	283.2	213.0	241.5	296.3	–

$LSD_{0,05}$ for:
years 3.3 tillage systems 2.8 weed control methods 5.5
interaction
tillage systems × weed control methods ns
years × weed control methods ns

No significant correlation was indicated between years and methods of weed control.

Statistical analysis did not indicate any significant effect of the tillage system on plant damage, either for the conventional or reduced tillage. They were the same and equalled 2.2 according to the EWRC scale (Table 4). However, the analysis of variance indicated a significant effect of weed control methods on the damage caused in yellow lupine plants. The greatest damage was observed on the plots where the herbicide combination was applied: after sowing Afalon Dyspersyjny 450 SC, and next after emergence at the three-leaf stage Metron 700 SL + Fusilade Forte 150 EC. The mean value of damage according to the 9-degree EWRC scale was 3.2. However, the lowest damage (on average 1.6) was found for the herbicide Afalon Dyspersyjny 450 SC, which was applied directly after sowing lupine seeds.

Moreover, the factors that significantly affected the degree of lupine damage by herbicides were the humidity and thermal conditions that occurred in particular growing seasons. The results of our studies concerning the selectivity of herbicides are in line with the results of Dewitte *et al.* (2006) as well as Si *et al.* (2012). These authors indicate the genotypic resistance of the lupine cultivars studied by them, and the damage observed by these researchers was slight and transient. Also, Sekutowski and Badowski (2011) found that herbicides used in the cultivation of field pea are fully selective towards the crop plant. However, from the research of Kaczmarek and Adamczewski (2007) it follows that herbicides used in the cultivation of phacelia caused damage such as: growth inhibition and decrease in plant density per unit of area.

Statistical analysis indicated the significant effect of tillage systems, methods of weed control and weather conditions on the seed yield of yellow lupine (Table 5). Depending on the tillage system, the highest seed yield of lupine (1.73 $Mg \cdot ha^{-1}$) was obtained after conventional tillage, and it was on average 0.35 $Mg \cdot ha^{-1}$ higher when compared with the yield obtained from reduced tillage. The obtained results are in line with the studies of Piekarczyk (2006), who found a significant decrease in the lupine yield as a result of omitting post-harvest tillage when compared with conventional post-harvest tillage. However, a different opinion is offered by Faligowska and Szukała (2007), who obtained the highest seed yield in a three-year research cycle from a reduced tillage system.

The highest seed yield of yellow lupine (on average 2.15 $Mg \cdot ha^{-1}$) was obtained on the plots where a combination of three preparations was used: Afalon Dyspersyjny 450 SC and after the plants had reached a height of 5 cm the herbicide combination of Metamitron 700 SL and graminicide Fusilade Forte 150 EC. Also, the studies of Stupnicka-Rodzynkiewicz *et al.* (2003) indicated that mean seed yields of lupine on plots sprayed with preparations Pivot 100 SL and Pivot 100 SL + Sencor 70 WG were significantly higher than on the control plot. On the other hand, Bujak and Frant (2009) did not find any significant effect of herbicide combinations on soybean seed yield.

The seed yield of yellow lupine was significantly diversified in particular years of the research. The highest yield, on average 1.71 $Mg \cdot ha^{-1}$, was obtained in 2008, which was characterized by a uniform distribution of rainfall and temperatures over the growing season. The lowest seed yield, on average 1.45 $Mg \cdot ha^{-1}$, was harvested in 2010, which was characterized by the highest air temperature and the highest rainfall when compared with the long-term mean.

Bieniaszewski *et al.* (2012) have also indicated in their studies that seed yield of the studied yellow lupine cultivars in particular years of research was visibly diversified. A similar opinion is also expressed by other authors: Alvino and Leone (1993), Fougereux *et al.* (1997), Krześlak and Sadowski (1997), Prusiński and Kaszkowiak (2005) as well as Piekarczyk (2006), who also argue that the course of weather conditions in particular years of research has an essential effect on the level of yields of fabaceae species.

Table 4. Phytotoxicity of herbicides to lupine yellow plants according to EWRC 1-9

Weed control methods	Tillage systems		Year			Mean
	conventional	reduced	2008	2009	2010	
Control – Harrowing 3x	1.0	1.0	1.0	1.0	1.0	1.0
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$	1.6	1.6	1.2	2.0	1.6	1.6
Harrowing 3x + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	2.1	2.1	1.7	2.4	1.9	2.1
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	2.9	2.9	2.7	3.2	2.8	2.9
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL(metamitron) – 4,0 $dm^3 \cdot ha^{-1}$ + Fusilade Forte 150 EC (fluazyfop-P butylu) – 1,5 $dm^3 \cdot ha^{-1}$	3.2	3.2	2.9	3.6	3.1	3.2
Mean	2.2	2.2	1.9	2.4	2.1	–

$LSD_{0,05}$ for:
years 0.38 tillage systems ns weed control methods 1.62
interaction
tillage systems × weed control methods ns
years × weed control methods ns

Tabela 5. Seed yield of lupine yellow, $Mg \cdot ha^{-1}$

Weed control methods	Tillage systems		Year			Mean
	conventional	reduced	2008	2009	2010	
Control – Harrowing 3x	1.16	0.96	1.13	1.03	1.03	1.06
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$	1.27	1.02	1.2	1.14	1.11	1.15
Harrowing 3x + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	1.59	1.32	1.53	1.41	1.43	1.46
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL (metamitron) – 4,0 $dm^3 \cdot ha^{-1}$	2.14	1.81	2.18	1.92	1.83	1.97
Afalon Dyspersyjny 450 SC (linuron) – 1,5 $dm^3 \cdot ha^{-1}$ + Metron 700 SL(metamitron) – 4,0 $dm^3 \cdot ha^{-1}$ + Fusilade Forte 150 EC (fluazyfop-P butylu) – 1,5 $dm^3 \cdot ha^{-1}$	2.50	1.80	2.51	2.07	1.86	2.15
Mean	1.73	1.38	1.71	1.51	1.45	–

$LSD_{0,05}$ for:
years 0.13 tillage systems 0.11 weed control methods 0.43
interaction
tillage systems × weed control methods ns
years × weed control methods ns

CONCLUSIONS

1. Irrespective of the tillage system the herbicides applied in the experiment in each year of the research caused transient damage, which did not affect the growth and development of yellow lupine plants.
2. The lowest air dry mass of weeds was found after applying the herbicide combination Afalon Dyspersyjny 450 SC + Metron 700 SL + Fusilade Forte 150 EC in conventional tillage.
3. Seed yield of yellow lupine was significantly modified by tillage systems, methods of weed control as well as humidity and thermal conditions that occurred in particular years of the research.
4. The highest seed yield was observed with conventional tillage where the herbicide combination Afalon Dyspersyjny 450 SC + Metron 700 SL + Fusilade Forte 150 EC was used for weed control in yellow lupine.
5. Diversified weather conditions in particular years of the research significantly affected the amount of the dry weight of weeds and of the seed yield of yellow lupine.
6. In respect of weather conditions, 2008 was the most favourable year as the mean weed mass obtained from plots was the lowest while the mean seed yield was the highest.

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WPŁYW SPOSOBÓW UPRAWY I METOD ODCHWASZCZANIA NA PLONOWANIE ŁUBINU ŻÓŁTEGO (*Lupinus luteus* L.)

Streszczenie

Uproszczone systemy uprawy roli pozwalają ograniczyć nakłady energetyczne i poprawić ekonomiczną efektywność produkcji, ale m.in. sprzyjają zachwaszczeniu plantacji. Celem badań było określenie wpływu uprawy roli i sposobów pielęgnacji na ograniczenie masy chwastów, określenie fitotoksycznego oddziaływania stosowanych herbicydów na rośliny łubinu żółtego oraz na jego plonowanie. Wyniki badań pochodzą z doświadczenia polowego założonego w układzie split-plot w trzech powtórzeniach. Badanymi czynnikami były: I – dwie metody uprawy roli – tradycyjna i uproszczona; II – pięć sposobów odchwaszczania: 1) obiekt kontrolny – pielęgnacja mechaniczna, 2) pielęgnacja chemiczna – bezpośrednio po siewie opryskiwanie preparatem Afalon Dyspersyjny 450 SC (linuron), 3) pielęgnacja mechaniczno-chemiczna [Metron 700 SL (metamitron)], 4) pielęgnacja chemiczna – Afalon Dyspersyjny 450 SC + Metron 700 SL, 5) pielęgnacja chemiczna – Afalon Dyspersyjny 450 SC + Metron 700 SL + Fusilade Forte 150 EC (fluazyfop-P butylu). Ocenę zachwaszczenia wykonano dwa tygodnie po zastosowaniu ostatniego zabiegu herbicydowego oraz bezpośrednio przed zbiorem nasion łubinu żółtego. Stosowane w doświadczeniu sposoby uprawy roli miały podobny wpływ na wartość powietrznie suchej masy chwastów oznaczonej w obu terminach badań. Powietrznie sucha masa chwastów była mniejsza po uprawie tradycyjnej niż uproszczonej. Najmniejszą wartość miała sucha masa chwastów po zastosowaniu uprawy tradycyjnej i trzech herbicydów, a największą na obiekcie kontrolnym, odpowiednio – 125.6 i 450,8 $g \cdot m^{-2}$. Największe uszkodzenia roślin zaobserwowano po zastosowaniu trzech herbicydów. Plon nasion łubinu żółtego był w istotny sposób modyfikowany przez metody uprawy roli, sposoby odchwaszczania oraz warunki meteorologiczne panujące w poszczególnych sezonach wegetacyjnych.

Słowa kluczowe: fitotoksyczność, herbicydy, pielęgnacja mechaniczna, plon nasion, selektywność, uproszczona uprawa roli