

INFLUENCE OF HERBICIDES AND ORGANIC MULCHES ON YIELD AND QUALITY OF FLOWERS OF *Acidanthera bicolor* VAR. *murielae* Perry

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Abstract. The experiment was carried out at the Department of Ornamental Plants in the Agricultural University in Lublin in the years 2000–2002. The plant material was corms of *Acidanthera bicolor* var. *murielae* Perry with a circumference of 8–9 cm, which in number of thirty was planted on a plot 1.2 m², at 8 cm of depth in the second week of May. According to the scheme of experiment: linuron 1.000 kg·ha⁻¹, pendimethalin 0.990 kg·ha⁻¹ and napropamide 1.500 kg·ha⁻¹ were applied one week after planting the corms of the research plant. Next day some plots were mulched with 5 cm thick layer of pine bark or peat. The experiment included also a control set without herbicides and mulches, which it was hand weeded and a control set with delay hand weed performed three week late compared with the rest plots. At the end of vegetative stage the measurement was carried out on 10 plants of each plot including: length of flower stem, number of flowers and length of spike. It was noted that linuron, pendimethalin and napropamide did not injury to plants of *Acidanthera bicolor*. Application of linuron and pendimethalin beneficially influenced on number of flowers (respectively by 9.65 and 9.72 pieces·plant⁻¹), length of flower stem (respectively by 102.54 and 101.52 cm) and length of spike (respectively by 40.14 and 40.28 cm). Besides application of napropamide had a positive effect on received of greater number of flowers (9.40 pieces·plant⁻¹) and longer spike (39.60 cm). Delay of hand weed about three weeks had a negative effect on yield and quality of flowers of the research plant which formed the smaller number of flowers and the shortest flower stems and spikes (respectively by 8.4 pieces·plant⁻¹, 96.2 cm and 35.4 cm). It was received the longer flower stems in combinations where applied of pine bark or peat as a mulch (respectively by 100.88 and 100.23 cm) in comparison with combination without mulch (97.96 cm). There was no noted considerably influence of organic mulches on number of flowers in spike and length of inflorescence.

Key words: *Acidanthera bicolor*, linuron, pendimethalin, napropamide, bark, peat, yield, quality of flowers

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INTRODUCTION

Acidanthera bicolor var. *murielae* Perry natives from tropical and mountainous region of Ethiopia [Kurdziel 1992, Philips and Rix 1981]. It includes to tender bulbs which does not winter in the field in continental climate [Bryan 1989, Grabowska et al. 1987], because it's injured at temperatures below 2°C [Hertogh and Nard 1993]. During vegetative stage *Acidanthera* forms stem 70–100 cm long, slightly arched and 3–4 sword-shaped, linear leaves about half as long as stem [Bryan and Griffiths 1992, Grabowska et al. 1987, Huxley et al. 1992, Krause 1992]. During its blooming occurs in our climate in August to September it has 6–7 flowers set by loose flower spikes [Grabowska et al. 1987, Hertogh and Nard 1993, Huxley et al. 1992, Krause 1992, Kurdziel 1992]. Subtle fragrant flowers are 5–10 cm in diameter and have white lobes with a purplish red mark in throat [Bryan 1989, Hertogh and Nard 1993, Krause 1992, Philips and Rix 1981].

The monocotyledons are very sensitive to appear of weeds in cultivation, particularly at the early stage of growth. In order to avoid competition ornamental plant with weeds generally apply herbicides. Among herbicides good effect of weeds control in bulbs cultivation noted by using of linuron, pendimethalin and napropamide [Arora et al. 2002, Kwon et al. 1996, Rolewska and Saniewski 1978]. These herbicides were selective by *Acidanthera bicolor*, *Sparaxis tricolor* [Hetman and Marcinek 2001, Kocira and Laskowska 2005, Marcinek and Hetman 2005]. Application of pendimethalin and napropamide in tulip cultivation did not injury of plants [Jagusz 1988]. It was noted that napropamide was selective by gladiolus plant [Jagusz and Borowy 1984]. Research carried out by Kwon et al. [1996] proved that linuron, pendimethalin and napropamide slight injured at the early stage of gladiolus growth. Delay time of hand weed had unfavourably effect on growth and blooming of gladiolus, *Acidanthera bicolor* and *Sparaxis tricolor*, [Jagusz and Borowy 1984, Hetman and Marcinek 2001, Kocira and Laskowska 2005, Marcinek and Hetman 2005, Rolewska and Saniewski 1978].

Mulching the soil surface affects the physical, chemical and biological properties and processes of the soil. Mulch has a substantial effect on weeds control by inhibiting their emergence and growth [Rao 2000]. Mulching increases soil temperature, which enhances plant growth and protects its by rapid fluctuations of temperature [Rao 2000, Robinson 1988]. Mulching the soil surface by organic materials prevents it from loss of water by evaporation, increased soil moisture and protects against negative effect of raindrops, which destroy soil aggregates [Robinson 1988, Słowińska-Jurkiewicz 1994]. Application of peat mulch on soil surface mitigates yield losses caused by adverse weather conditions by stabilizing the structure of the surface and by reducing evaporative water losses in dry periods [Mc Afee et al. 1989]. Mulching of peat also increase contents of humus in soil [Katutis 1990]. Composted pine bark used as a mulch improves the growth and blooming of gladiolus plants. Application of this kind of mulch decreases weeds on gladiolus cultivation and has a positive influence at improve the physical properties of soil, stabilization of soil temperature, increase its moisture and water capacity [Grzeszkiewicz 1978, Wiśniewska-Grzeszkiewicz 1982].

The aim of this experiment was to examine the effect of herbicides: linuron, pendimethalin, napropamide and organic mulches: pine bark and peat on length of flower stem, number of flowers and length of spike of *Acidanthera bicolor* var. *murielae*.

MATERIAL AND METHODS

In the period 2000–2002 a field experiment was carried out at the Department of Ornamental Plants in the Agricultural University in Lublin. *Acidanthera bicolor* var. *murielae* corms with a circumference of 8–9 cm were planted at the depth 8 cm in the second week of May in number of thirty corms on a plot of 1.2 m². According to the scheme of experiment: linuron 1.000 kg·ha⁻¹, pendimethalin 0.990 kg·ha⁻¹ and napropamide 1.500 kg·ha⁻¹ were applied one week after planting the corms of the research plant. Next day some plots were mulched with 5 cm thick layer of pine bark or peat. The experiment included also a control set without herbicides and mulches, which it was hand weeded and a control set with delay hand weed performed three week late compared with the rest plots. At the end of vegetative stage the measurement was carried out on 10 plants of each plot including: length of flower stem, number of flowers and length of spike. The experiment was established on the basis of random blocks in five repetitions. The method of a two-factor variance analysis of the orthogonal data was used and differences were verified using Tukey's test at 0.05 level of significance.

RESULTS

The greatest number of flowers in spike between 9.40–9.72 pieces·plant⁻¹ were noted in combinations where applied herbicides (tab. 1). With control set independent of time hand weed was received smaller number of flowers (respectively by 8.55 and 8.41 pieces·plant⁻¹). Lack of influence of mulches on the number of flowers in spike was proved. It was noted that the greatest number of flowers (from 9.61 to 9.83 pieces·plant⁻¹) formed plants from combinations where applied linuron, pendimethalin, napropamide without mulch and pendimethalin with mulch of pine bark or peat. Plants which grew in control set with delay hand weed and mulching of bark peat formed the smallest number of flowers (from 8.35 pieces·plant⁻¹).

The longest flower stems were noted in combinations where applied linuron and pendimethalin (respectively by 102.54 and 101.52 cm) in comparison with control set with delay hand weed (96.18 cm). Mulching of soil surface with pine bark or peat was conducive to forming of longer flower stems (respectively by 100.88 and 100.23 cm) compared with control set (97.96 cm). Plants from combinations where applied linuron with mulch of peat and pendimethalin with mulch of pine bark formed the longest flower stems (respectively by 103.58 and 102.93 cm). Delay of hand weed about three weeks in comparison with the rest of plots unfavourable influenced on plants, which formed the shortest flower stems (93.77 cm).

Table 1. The influence of herbicides and mulches on yield and quality of flowers of *Acidanthera bicolor* var. *murielae* (mean of three years)
 Tabela 1. Wpływ herbicydów i ściółek na plon i jakość kwiatów acidantery dwubarwnej odm. *murielae* (średnia z trzech lat)

Herbicide Herbicyd	Trait – Cecha											
	number of flowers, pieces plant ⁻¹ liczba kwiatów, szt.-rośl. ⁻¹				length of flower stem, cm długość pędu kwiatostanowego, cm				length of spike, cm długość kłosa, cm			
	bark kora	peat torf	without mulch brak ściółki	mean średnia	bark kora	peat torf	without mulch brak ściółki	mean średnia	bark kora	peat torf	without mulch brak ściółki	mean średnia
Linuron	9.57 cd	9.58 cd	9.80 d	9.65 b	102.65 cd	103.58 d	101.37 bcd	102.54 c	40.41 c	40.51 c	39.50 bc	40.14 c
Pendimethalin	9.83 d	9.72 d	9.61 d	9.72 B	102.93 d	102.31 cd	99.31 a-d	101.52 C	40.90 c	40.46 c	39.47 bc	40.28 C
Napropamide	9.33 bcd	9.22 a-d	9.63 d	9.40 B	101.71 bcd	100.14 bcd	99.50 a-d	100.45 BC	39.63 bc	39.72 bc	39.46 bc	39.60 C
Control – Kontrola	8.43 ab	8.63 abc	8.59 ab	8.55 A	99.07 a-d	98.39 a-d	95.87 ab	97.78 AB	37.11 ab	37.75 abc	36.94 ab	37.27 B
Control with delay hand weed Kontrola z opóźnionym pielaniem	8.35 a	8.42 ab	8.47 ab	8.41 A	98.03 a-d	96.74 abc	93.77 a	96.18 A	35.37 a	35.58 a	35.38 a	35.44 A
Mean – Średnia	9.10	9.11	9.22		100.88 B	100.23 B	97.96 A		38.68	38.81	38.15	

Means marked with the same letter do not differ significantly at $\alpha = 0.05$
 Średnie oznaczone tą samą literą nie różnią się istotnie dla $\alpha = 0.05$

It was noted that plants from combinations where applied herbicides were characterized by the longest spike (from 39.60 to 40.28 cm). The smallest inflorescences were received in control set with delay hand weed (35.44 cm). No influence of mulch on the length of inflorescence was proved. Mulching of soil surface with pine bark or peat in combinations where applied linuron and pendimethalin was conducive to forming of longer spikes (from 40.41 to 40.90 cm). Delay of hand weed independent of using mulches unfavourable influenced on plants, which formed the shortest inflorescences containing between 35.37–35.58 cm.

DISCUSSION

In own research noted that linuron, pendimethalin and napropamide were selective by *Acidanthera bicolor*. Research carried out on *Sparaxis tricolor* proved that these herbicides did not injury to plants [Hetman and Marcinek 2001, Marcinek and Hetman 2005]. Application of pendimethalin and napropamide caused slight injury to gladiolus and tulip plants at the early stage of their growth [Hetman et al. 1984, Kwon et al. 1996, Al-Khatib 1996]. Kwon et al. [1996] and Mynett and Jagusz [1990] noted that gladiolus plants at the early stage of growth were slight injured by linuron, although it had not negative influence on their blooming and corms yield.

The results presented in this research show that these herbicides beneficially influenced on weeds control and it was conducive to forming of greatest number of flowers and longer spikes. Besides the longest flower stems obtained in combinations where linuron and pendimethalin were applied. It was proved that application of lower dose of linuron and pendimethalin in gladiolus cultivation beneficially influenced on blooming plants [Arora et al. 2002]. According with research carried out on *Polianthes tuberosa* it was noted that application of pendimethalin positive influenced on flowers yield [Murthy and Gowda 1993].

The results obtained in own research proved that mulch of pine bark or peat beneficially influenced on length of flower stem of *Acidanthera bicolor*.

Similarly to *Acidanthera bicolor*, gladiolus beneficially responded to mulching of pine bark or peat by obtainment of longer plants with longer flower stems. Mulching with pine bark also conduced to form the greater flowers by plant [Grzeszkiewicz 1978, Wiśniewska-Grzeszkiewicz 1982]. Application of pine bark by covering the soil surface beneficially influenced narcissus blooming and tulip growth [Levai and Farkas 2000, Marcinkowski 1975]. In cultivation of *Liatris spicata* it was noticed that mulch of pine bark reduced flowers yield, but also improved their quality [Hetman and Pogroszewska 1997].

Research on lingonberry proved that mulch of peat or pine bark conduced growth of plants [Gustavsson and Paal 1998, Gustavsson 1999, Pliszka et al. 1993, Starast et al. 2002]. It is also reasonable to apply the pine bark mulch in an orchard of apple, as it results in producing better biotope conditions of young trees on their better growth [Darbellay and Fournier 1996, Szewczuk et al. 1995].

CONCLUSIONS

1. Linuron, pendimethalin and napropamide do not injury to plants of *Acidanthera bicolor*.
2. Application of linuron and pendimethalin beneficially influence on length of flower stem, number of flowers and length of spike. Besides application of napropamide have a positive effect on number of flowers and length of spike.
3. Delay of hand weed about three weeks has a negative effect on growth and blooming of the research plant which forms the shortest flower stems and spikes and smaller number of flowers.
4. Application of mulches with organic materials in *Acidanthera bicolor* cultivation is suggested in consideration of morphological traits profitably influence on increase decorative value of plant.
5. Mulching of soil by pine bark or peat results in long flower stem of *Acidanthera bicolor*.

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WPLYW HERBICYDÓW I ŚCIÓŁEK ORGANICZNYCH NA PLON I JAKOŚĆ KWIATÓW ACIDANTERY DWUBARWNEJ ODM. *murielae*

Streszczenie: Doświadczenie przeprowadzono w latach 2000–2002 w Katedrze Roślin Ozdobnych AR w Lublinie. Materiał roślinny stanowiły bulwy acidantery dwubarwnej o obwodzie 8–9 cm, które w liczbie 30 sztuk sadzono w drugim tygodniu maja na poletko o powierzchni 1,2 m² na głębokości 8 cm. Zgodnie ze schematem doświadczenia zastosowano: linuron 1,000 kg·ha⁻¹, pendimetalinę 0,990 kg·ha⁻¹ i napropamid 1,500 kg·ha⁻¹ tydzień po sadzeniu bulw badanej rośliny. Następnego dnia część poletek ściółkowano 5 cm warstwą kory sosnowej lub torfu. Doświadczenie obejmowało również kombinację kontrolną, gdzie nie stosowano herbicydów i ściótek, w której ręcznie pielono i kombinację kontrolną z opóźnionym ręcznym pielaniem przeprowadzonym trzy tygodnie później w stosunku do pozostałych poletek. Pod koniec okresu wegetacji wykonano pomiary na 10 roślinach z każdego poletka obejmujące: długość pędu kwiatostanowego, liczbę kwiatów i długość kwiatostanu. Stwierdzono, że linuron, pendimetalina i napropamid nie uszkadzały roślin acidantery dwubarwnej. Zastosowanie linuronu i pendimetaliny korzystnie wpłynęło na liczbę kwiatów (odpowiednio 9,65 i 9,72 szt.·rośl.⁻¹), długość pędu kwiatostanowego (odpowiednio 102,54 i 101,52 cm) i długość kłosa (odpowiednio 40,14 i 40,28 cm). Ponadto zastosowanie napropamidu dało pozytywne efekty w uzyskaniu większej liczby kwiatów (9,40 szt.·rośl.⁻¹) i dłuższego kłosa (39,60 cm). Opóźnienie ręcznego pielania o trzy tygodnie negatywnie wpłynęło na plon i jakość kwiatów badanej rośliny, która wykształciła mniejszą liczbę kwiatów oraz najkrótsze pędy kwiatostanowe i kłosa (odpowiednio 8,41 szt.·rośl.⁻¹, 96,18 cm i 35,44 cm). Dłuższe pędy kwiatostanowe otrzymano w kombinacjach, gdzie zastosowano korę sosnową i torf jako ściółkę (odpowiednio 100,88 i 100,23 cm) w stosunku do kombinacji w której nie stosowano ściółki (97,96 cm). Nie stwierdzono istotnego wpływu ściótek organicznych na liczbę kwiatów w kłosie i długość kwiatostanu.

Słowa kluczowe: acidantera dwubarwna, linuron, pendimetalina, napropamid, kora, torf, plon, jakość kwiatów

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