Changes in weed flora depending on the rate of manure on acid and limed soils

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Liming and manure application on acid soils contribute to the improvement of soil agrochemical properties and ecological conditions for plant growth. Rates of manure had a diverse effect on weed infestation of crop stands on acid and limed soils. *Scleranthus annus* L., *Spergula arvensis* L predominated on acid soil, and *Chenopodium album* L on limed soil. The number of acidophilic weeds decreased and the number of nitrophilous weeds increased the effect of manure.

Key words: weed flora, acid soil, limed soil, manure

INTRODUCTION

Most soils in Western, Eastern and South-eastern Lithuania are originally acid. Until 1991 when 180–200 thousand hectares had been limed annually, the area of acid soils (pH 5.5 and less) declined to 18.7% [1, 2]. A rise in the price of energy inputs and a shortage of means over the last years have resulted in a sharp decline in liming volumes, which consequently resulted in a higher activity of soil acidification process. Due to leaching and removal with yield the soil arable layer loses up to 400 kg/ha of calcium carbonate annually [1, 4]. In acid and acidifying soils plant growth ecological conditions can be improved by liming, as well as by organic fertilisation. Major plant nutrients are introduced into the soil with manure. Calcium present in manure neutralises mobile aluminium, noxious to plants, and softens soil reaction [4, 5]. However, many weed seeds can be introduced into the soil with manure, too. With 40 t/ha of manure the soil can receive about 18.5 million weed seeds [6]. Therefore manure fertilisation increases the stocks of weed seeds in the soil, which can result in changes in weed botanical composition [6–8]. Soil reaction and liming have some effect on weed infestation in the crop stands. In acid soils acidophilic weeds that can withstand Ca deficit in the soil are predominant in crop stands, they include *Scleranthus annus* L., *Spergula arvensis* L., *Viola arvensis* Murr. [4, 9–11]. However, a reduction in the number of *Spergula arvensis* L., *Rumex acetosella* L. occurs after liming, while an increase occurs in the number of *Chenopodium album* L., *Stellaria media* (L.) Vill. [12].

Liming of acid soils, acidification of limed soils as well as organic fertilisation result in changes in soil ecological conditions for plant growth. Therefore it is important to be aware of weed abundance and changes in weed botanical composition in crop stands, in ecological farming in particular.

MATERIALS AND METHODS

Two stationary long-term field trials are being carried out since 1959 on derno-podzolic sandy loam soil. The effects of different rates of manure (20, 40, 80 and 120 t/ha^{-1}) are investigated on soil productivity and agrochemical physical, biological properties of acid (pH_{KCl} 4.3) and limed (pH_{KCl} 5.8) soil. The crop rotation was 7 years long: winter wheat, oat–vetch mixture, oats, fodder beet, spring barley, perennial grasses (2 years). The soil was limed before the establishment of the experiment and later on every 7 years. Manure was incorporated into the soil at half rate before winter wheat and the other half before fodder beet.

The objectives of the present experiments were to investigate changes in weed flora and their ambundance at different rates of manure in sixth crop rotation. Weed assessment was performed in 4 places of 0.25 m^2 each in every plot. Regression analysis was used to study a relationship between the rate of manure and weed density.

RESULTS AND DISCUSSIONS

Systematic manure application had a significant effect on soil agrochemical properties in acid and li-

Table 1. **Influence of rate of manure on weeds in acid and limed soil, number of weeds m^{-1} (average data of 1997–2000)**

Manure t ha^{-1}	Total number weeds m^{-1}	Among them prevailing weeds								
		Capsella bursa pastoris L.	*Chenopodium album* L.	*Galeopsis tetrahit* L.	*Polygonum species* L.	*Raphanus raphanistrum* L.	*Scleranthus annus* L.	*Spergula arvensis* L.	*Viola arvensis* Mirr.	*Rumex acetosella* L.
Acid soil (pH_{KCl} 4.3)										
0	205.5	0.3	29.4	3.5	12.5	11.4	35.6	100.0	3.1	0.4
20	214.8	0.3	26.0	5.5	10.1	19.5	25.7	113.8	4.7	0.1
40	190.5	0.8	34.8	4.6	11.8	14.8	20.4	88.1	5.9	0.3
80	160.7	1.0	54.6	3.9	9.7	10.6	11.0	48.0	6.1	0.1
120	151.4	1.7	60.9	3.4	11.1	7.2	14.1	33.8	4.8	0.2
r	–0.95	0.97	0.96			–0.68	–0.91	–0.96		
Limed soil (pH_{KCl} 5.8)										
0	79.5	3.6	37.5	0.6	4.5	0.9	1.3	15.4	0.6	0.0
20	75.8	4.7	36.2	1.3	5.6	1.3	1.1	10.7	1.2	0.0
40	80.2	4.5	43.7	1.0	4.9	1.0	0.5	9.2	0.9	0.0
80	88.4	5.0	52.5	0.7	4.9	0.6	0.5	8.1	1.5	0.0
120	83.4	5.3	48.3	0.5	4.0	0.7	0.7	5.3	1.7	0.0
r	0.69	0.87	0.84			–0.68	–0.87	–0.92		

med soils. With increasing the manure rate from 20 to 120 t/ha, the acidity of the first soil declined from 4.2 to 4.5 pH and of the second soil from 5.6 to 5.8 pH. The content of plant-noxious aluminium declined from 114.7 to 2.92 mg/kg and from 2.4 to 0.74 mg/kg of soil, respectively. The content of humus in acid soil under the effect of manure increased from 1.92 to 2.46%, and in limed soil from 1.92 to 2.5%. In both types of soils an increase in plant-available mobile phosphorus and potassium occurred.

Changes in the ecological conditions for plant growth in the soil had a diverse effect on the botanical composition of weeds and on their abundance in the crop stands in acid and limed soils. In acid soil not fertilised with farmyard manure, acidophilic weeds *Scleranthus annus* L. and *Spergula arvensis* L predominated. Cultivated crops demonstrated a poor performance, therefore weeds had favourable conditions for establishment. In the crop stands on limed soils richer in nutrients, nitrophilous weed *Chenopodium album* L. was predominant, the number of *Sonchus arvensis* L. increased, and *Rumex acetosella* L disappeared (Table). As compared to acid soil, limed soil contained fewer *Scleranthus annus* L., *Spergula arvensis* L., *Raphanus raphanistrum* L., *Galeopsis tetrahit* L. Increasing the rate of manure in the crop stands on acid soils resulted in 26.3% reduction of weeds as compared with the crops grown on the soil not treated with manure. A strong negative correlation was established between the number of weeds and rates of manure (r = –0.86). The number of *Scleranthus annus* L. and *Spergula arvensis* L. (64.7%, r = –0.83), *Rumex acetosella* L. decreased. Upon manuring acid soil a marked increase in *Chenopodium album* L. (107.1%), *Capsella bursa-pastoris* (L.) Medik., *Viola arvensis* Murr occurred.

On increasing the rate of manure from 20 to 120 t/ha on limed soil, cultivated plants performed better and demonstrated a better suppressive power on weeds, however, weed infestation increased by 5.0%. There was a higher number of *Chenopodium album* L. (28.8%), *Capsella bursa-pastoris* (L.) Medik. (47.2%), *Viola arvensis* Murr. (183.3%), *Stellaria media* (L.) Vill. (225%) as compared to the crop stands grown on the soil not treated with manure. These were nitrophilic weeds showing a positive response to a higher nutrient content introduced into the soil with manure. Besides, manure contains up to 24% of *Chenopodium album* L. seeds which get into the soil [2]. As compared with acid soil, limed soil contained much less *Galeopsis tetrahit* L., *Raphanus raphanistrum* L., *Polygonum* sp.

On acid soils, the highest weed infestation was recorded in the stands of oats, fodder beets, oats–vetch mixture, while a lower weed infestation was found in the stands of spring barley. On limed soil, the highest number of weeds was also found in the stands of oats. However, their number here was 2.1–2.7 times lower than in the stands on acid soils.

CONCLUSIONS

Systematic soil liming and manure application had a significant effect on the variation of agrochemical indicators as well as on the ecological conditions of plant growth.

When the rate of manure had been increased to 120 t/ha, the number of weeds in acid soil in the crops of the sixth rotation decreased by 26.3%. There were fewer *Scleranthus annus* L., *Spergula arvensis* L., *Rumex acetosella* L in the stand. Under the effect of manure the number of *Chenopodium album* L., *Capsella bursa-pastoris* (L.) Medik., *Viola arvensis* Murr increased.

In limed soil when the rate of manure had been increased to 120 t/ha, the number of weeds in the crop stands increased by 5%. In such soil the weed infestation in crop stands was 2.6 times lower than in acid soil. There was a higher number of *Chenopodium album* L., *Capsella bursa-pastoris* (L.) Medik., *Stellaria media* (L.) Vill., *Viola arvensis* Murr., *Spergula arvensis* L., *Rumex acetosella* L disappeared completely.

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PIKTŽOLIŲ FLOROS PASIKEITIMAS RŪGŠČIOJE IR KALKINTOJE DIRVOSE PRIKLAUSOMAI NUO MĖŠLO NORMŲ

S a n t r a u k a

Rūgščių dirvožemių kalkinimas ir tręšimas mėšlu pagerina dirvožemio agrochemines savybes bei augalų augimo ekologines sąlygas. Mėšlo normos turėjo nevienodą įtaką pasėlių piktžolėtumui rūgščioje ir kalkintoje dirvoje. Rūgščioje dirvoje vyravo *Scleranthus annus* L., *Spergula arvensis* L., kalkintoje – *Chenopodium album* L. Dėl mėšlo mažėjo acidofilinių piktžolių, daugėjo nitrofilinių piktžolių.

Raktažodžiai: piktžolių flora, rūgšti dirva, kalkinta dirva, mėšlas