PRESERVATION OF WEEDS DIVERSITY IN PROTECTED AREAS

Denise F. DOSTATNY

National Centre for Plant Genetic Resources – Plant Breeding and Acclimatization Institute 05-870 Błonie Warszawa – Poland e-mail: d.dostatny@ihar.edu.pl

SUMMARY

In many regions of Europe, as well as in Poland, fields have been recently subjected to violent and often irreversible changes due to intensive intervention of a man in the agroecosystems, which results not only from the changes of methods of land and plant cultivation, but also from the increasing use of farming machinery, herbicides and devastation of the natural environment. This process is accompanied, apart from the phenomenon of expansion, by the effect of recession of many species of segetal plants and has produced monotonous landscapes that show increasing biodiversity losses. The survey area covers a landscape park, which has an administration office and a specific infrastructure, which may to a large extent help to introduce all the necessary changes in farming and which may help the farmers. Besides, the survey presented in this paper shows the rich and rare association of *Caucalido-Scandicetum*, which finds its optimal development conditions in rendzina soils, present on the unique area of Niecka Nidziańska in the south of Poland. The preservation of weeds diversity in the fields is of the highest importance for maintaining the balance in agroecosystems. Besides, it also preserves the possibility of pleasure derived from communion with nature.

INTRODUCTION

The segetal vegetation in Poland plays a considerable role in landscape, because approximately 40% of the country's area falls to arable lands (GUS, 2003). The research was carried out in the Nadnidziański Landscape Park (Nadnidziański LP) – one of the oldest agricultural areas in Poland, the so-called "old farming land", the soils of which, alkaline rendzinas,

account for a small percentage of arable lands in Poland.

In order to maintain and protect weeds diversity, we need first to become familiar with the diversity of weeds species in an area, then, to evaluate this diversity by means of diversity indices, next, to investigate the conditions of the diversity through abiotic habitat, methods and types of crops and propose such management methods within the area of agricultural lands, which would allow protection of weeds species threatened by extinction.

In the 20th century considerable transformations occurring both in natural communities and in synanthropic communities of segetal weeds were observed. The foregoing process results from the following factors: changes in farming methods (introduction of heavy agricultural equipment); introduction of more efficient methods of purifying the seeding material; excessive use of chemicals, including herbicides; introduction of new, competitively strong varieties of crop plants, abandoning cultivation of fields marked by unfavourable habitat conditions (too dry, too rocky). The foregoing changes, as well as abandoning of cultivation of older varieties caused many weed species to vanish until their terminal extinction, which is connected with a vehement expansion of other weed species; the above is called a compensation effect consisting in mass occurrence of resistant species which seize an ecological niche of other, more sensitive, e.g. to herbicides, species. (Holzner, Immonen 1982).

MATERIALS AND METHODS

In order to learn about weed communities in cereal crops phytosociological records were conducted using the Braun-Blanquet method (Braun-Blanquet 1964; Szafer, Zarzycki 1972) during the vegetation seasons of 1997–1998.

In order to compare percentage values of coverage of crop plants and weeds and their diversity, all records of cereal crops were divided into two groups: Group I included records conducted on fields, on which herbicides were improperly (excessively) used (this was stated based on the interviews with field owners and on the presence of traces of plant damage caused by the herbicides). Group II included records conducted on fields, on which herbicides were properly used.

RESULTS

Within the Nadnidziański Landscape Park 153 phytosociological records were set down among cereal crops. *Caucalido-Scandicetum* is an association, which most often accompanies cereal crops within this area, however we can also find other associations, such as *Lathyro-Melandrietum* and *Vicietum tetraspermae* or the alliance *Arnoseridion minimae* and communities with transitional patches.

A typical form of *Caucalido-Scandicetum* is marked by the occurrence of the following species: *Adonis aestivalis, Anagallis foemina, Bupleurum rotundifolium, Euphorbia falcata, Fumaria vaillantti* and *Melampyrum arvense.* From among the species characterizing the association *Caucalido-Scandicetum* haven't been found: *Allium rotundum, Conringia* orientalis, Galium tricorne and Adonis flammeus. The latter species was actually found, however not on arable fields. The two species after which the association had been named were not found, either, and these are: Caucalis daucoides and Scandix pecten-veneris.

In crops where herbicides were excessively used, Apera spica-venti, Avena fatua, Elymus repens and Poa annua had a high coverage level. The species of Apera spica-venti and Avena fatua are usually 30–50 cm higher than cereals and their inflorescences form a layer above the crop plant or are at the same level. At the same time, on those fields quantitativity of dicotyledonous weeds was low, they occurred in a few specimens only or a considerable number of them were withered. The only species that occurred here in a slightly higher number were: Chenopodium album, Convolvulus arvensis, Galium aparine and Tripleurospermum inodorum.

In order to compare different field weeds the records were divided into 2 groups: I and II (see methods). Figure 1 presents average values of percentage coverage of a crop plant, average weed coverage's and the number of weed species in the groups I and II. There is an enormous diversity of the variables in these groups. Patches of the plants belonging to the group I are marked by a high level of weeds coverage (between 50 and 70%) with the low coverage of



Fig. 1. Impact of the management method on coverage of crop plants and weeds and on number of weeds in cereal crops. Legend: I: records made in the fields, where herbicides were used excessively; II: records made in the fields without excessive use of herbicides.

the crop plant (between 55 and 65%). However, patches of plants belonging to the group II, including *Caucalido-Scandicetum* are marked by a low level of weeds coverage (between 20 and 30%) upon simultaneous high coverage of the crop plant (between 80 and 90%)

When analyzing records from the group I we can say, that individual species in this group occur in a few specimens only because they compete with one another, which results in a generally low level of weed coverage on these fields. This is important, as most probably a remarkable number of weed species do not reduce the crop plant's yield, because the crop plant's coverage level is very high on those fields.

Impoverishment of the floral composition, where one or two species of weeds predominate, often does not allow defining an association or even alliance to which a weed community in a given crop should be included. Such a situation is present in the case of the records classified to group I. However, in the records included to the group II where herbicides were not used, there are quite many species characteristic for the association *Caucalido-Scandicetum*.

In the arable fields communities of the Nadnidziański Landscape Park 170 species of weeds were noted. Communities which develop on rendzinas, particularly the patches belonging to the association *Caucalido-Scandicetum*, are florally very rich and usually have a bigger number of species than other associations that are present in the area of the Nadnidziański LP. In the fields where herbicides were applied excessively, one species – *Apera spica-venti*, which probably has already created biotypes resistant to herbicides, dominates. On such fields there are maximum 18 weed species.

DISCUSSION

The surveys presented in this paper show that *Caucalido-Scandicetum* is the weed association that is often present in cereal crops of the tested area (58 records among 153). The floral composition of this association from the whole area of Poland was given by Kornaś (1950), and from a part of the studied area (Skorocice) by Medwecka-Kornaś (1959). In comparison with those data the floral composition has impoverished currently. The species of the alliance *Caucalidion* most frequently occur in the southern Poland, where they constitute an integral part of nature and of cultural heritage related to agriculture. The whole world is currently creating gene banks, in the form of frozen seeds, in an attempt to rescue the vanishing species of different plants (Hammer and others, 1997), whereas the surveyed area makes it possible to preserve them *in situ*.

Apera spica-venti is a species that showed the highest level of coverage in 43 records where herbicides were excessively used in the fields. Similar data are given by Kukowski (1978). According to his experience there are such herbicides that destroyed *Apera spicaventi* to a small extent; and at the same time they destroyed from 55 to 100% dicotyledonous weeds. Such extermination of weeds causes a risk of creating an open niche where *Apera spica-venti* develops as expansive weed that can germinate the whole year round (Holzner, 1982; Trzcińska-Tacik, 2000; Trzcińska-Tacik, 2003).

The use of herbicides, for many years, for the purpose of killing dicotyledonous weeds, also affects compensation of dicotyledonous species, such as: *Chenopodium album*, *Convolvulus arvensis*, *Galium aparine* or *Tripleurospermum inodorum*, practically the only dicotyledonous species which occurred in considerable concentrations on fields where herbicides were excessively used, which is confirmed in research conducted by many authors from Poland and other European countries, such as Heller & Adamczewski, 2003; Kucharski & Rola, 2002; Mikulka & Chodová, 2002.

In the fields where herbicides are excessively and intensively used, one species is predominant. These communities patches of weeds are depleted in terms of their floral composition (lower diversity of weeds), but the mean cover of weeds in these fields is higher. However, when the herbicides aren't used excessively, the quantity of weed species in the field is high, but their general level of coverage is low, which is confirmed by Trzcińska-Tacik (2000).

Numerous studies indicate the expansion of certain weed species, as well as regression of

other, more sensitive species, such as the ones belonging to the association *Caucalido-Scandicetum* or the weed species related to flax-growing (Podyma, 2003; Warcholińska, 1986; Siciński & Sowa, 1980). The preservation of endangered agricultural environments of high natural value constitutes one of the goals included in the Regulations of the Council (EU) 1257/1999 and 1750/1999. The maintenance of traditional farming at small farms, without the use of chemical agents, will help to preserve various crop plants in their places of origin. Thus not only crop plants will be protected, but also the species that accompany them.

According to Herbich (1986), practical protection of field weeds should not be very challenging in the outer protection zones of national parks and reserves as well in the landscape parks, particularly when extensive farming is restored. A good didactic move would be the introduction of a primitive farming in the "old farming area", e.g. cultivation of plants typical for the region in the old times with the whole variety of weeds.

In the face of this, what are the recommendations regarding appropriate management on the areas under protection? Encouraging extensive farming without using herbicides and excessive use of fertilizers or heavy agricultural machinery (which change physical properties of soil); maintenance of traditional and region-specific crops; limitation of rotation the fields into permanent grassland; use of local seeding material originating from the region; purifying the seeding material using traditional methods; enrichment of the species composition of weed communities by complementary sowing of the seeds collected in the nearest vicinity or obtained while purifying the crops from adjacent fields; use of herbicides in a controlled way and moderate use of natural fertilizers; drawing up a list of weeds species, which should be protected in a given area.

Before any activities to this respect start, farmers should be educated. Special programmes are necessary to make farmers aware of the importance of such protection. Financial assistance is also necessary – subsidies to unprofitable crops. Such a programme should include the following: description of natural, environmental and structural features of the area in which such farming would be carried out; description of the proposed tasks and their justification in the light of the area's features; conditions for providing financial assistance, considering the problems faced; estimation of annual expenses for implementation of area programs; preparations made in order to secure appropriate information to farmers and other people concerned from rural areas.

The increase of the public awareness is also very important (Kalinowska, 2003). Usually, such areas already have several tourist tracks and are frequently visited by students. Programs of park visits should allow for visiting the stands with segetal plants, which will certainly help to increase the public awareness with relation to agro biodiversity.

Nevertheless, the most important thing in preservation and protection of weeds in protected areas is the fact that such areas have their own administration and all the proposed programs regarding the modification of cultivation methods or implementing extensive farming, as well as financing and taking care that a given farmer fulfils the provisions of the agreement, can be managed by administration of a given protected area.

CONCLUSION

The results of the present survey show that, where the rendzina is shallow and where slope inclinations are significant, typical patches of Caucalido-Scandicetum develop (the so-called "calciphilous association of cereal crops"). Basically, only on such type of habitats in south of Poland a few rare species from this association can be observed. These species should be obligatorily protected there, as long as it is still possible, in their natural habitats - in situ. The protection of rare weed species in situ constitutes a huge challenge for us, although it is well worth of effort, because preservation of these species in the form of living, functioning populations constitutes preservation of a part of nature and culture. In this way the future generations will be provided with a source of genes and with a possibility of the enjoying contact with nature.

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