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Original scientific paper

CAUSES OF AMORPHA (*AMORPHA FRUTICOSA L.*) INVASION OF FOREST SITES IN SERBIA

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The variability of amorpha morphophysiological characters in Serbia has been assessed at the level of trees, populations and species in general. A good phenotype is the result of multiannual selection (struggle for survival, selective value, etc.).

Key words: invasion, colonisation, weed, adaptation, control, breeding

INTRODUCTION

The capacity of subspontaneous spreading of plants to the new sites and their mass incorporation in the composition of the native plant communities is defined as invasion or colonisation (HERPER, 1977; GOLOKVIN, 1988, etc.). The invasion of trees or shrubs in forest communities is rare in our country and deserves special study, aiming at the control or improvement. The capacity of invasion characterises a few native species (aspen, blackberry, raspberry, roses, etc.) and a limited number of introduced trees and shrubs (ailanthus, red ash and green ash, amorpha, etc.) Amorpha is an introduced shrub species with marked

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invasion characters. Amorpha grows in Serbia at the sites of twenty different forest communities (TUCOVIĆ *et al.*, 2000, 2003). It is exclusively cultivated at eight sites as a reclamation, melliferous, ornamental and medicinal species. At the sites of twelve communities, it is a subspontaneous, wild species building more or less dense, weed pure synusias of the linear or more dimensional type, which prevent natural regeneration of ash, elm and pedunculate oak forests.

MATHERIALS AND METHODS

The cultivated stands or trees and subspontaneous populations in tree and shrub communities in Serbia were studied. The quantitative characters of trees and half-sib lines were measured in stationary stands and tests and then statistically analysed. The main statistical parameters were determined for each of the characters: mean value (X), standard deviation (S), variation coefficient (V) and their errors (Sx, Ss and Sv). The justification of statistical differences between the mean values was determined by Student's t test. This emphasises the need to explain the nature of the exceptional adaptation of amorpha shrubs, the character of special significance for both its control and improvement. The strategy of invasion capacity is realised at different levels and supported by various mechanisms whose identification is the subject of this study.

RESULTS AND DISCUSSION

Multiannual stationary and laboratory study of amorpha between 1998 and 2004, confirmed its specific genetically determined variability of many morphoanatomic and physiological characters, Table 1, which in interaction with environmental factors provide the genetic-physiological base of the species adaptation in general. The stability, competitiveness i.e. invasion capacity result from three levels of adaptation, Table 2: ontogenetic, population and phylogenetic. The full inventory of genetic potentials of trees, populations and species, as shown by the tests with cultural species, requires efforts and time invested by the world's science in the first phenotype inventory of the entire flora. The adaptation process develops at different levels: trees, populations and in the successive generations for each level, there is a specific form of adaptation, still insufficiently studied. The adaptation depending on the stage of development was not taken as significant until it was understood that an individual is exposed to natural selection in each phase of its life cycle. The variability per stages of development must be studied as the result of the interaction between genetic inheritance and selection. The significance of the levels conditioned the multiannual efforts on the improvement of the model of tree ontogenesis, Table 3. The effect of pod dispersal and individual variability on the dynamics of amorpha populations, Table 4, was observed by the study of populations, Scheme 1. The third phylogenetic level of adaptation, by the successive generations, Scheme 2, has a decisive role in the amorpha evolution, not only within the limits of cultigeneous range, but also its

subnspontaneous range. The phylogenetic adaptation depends not only on the number of trees, the struggle for survival, but also on the selection pressures, i.e. selection value, etc. Consequently, invasion capacity cannot be understood without some immanent contrasts: permanent surpassing of the genetic-physiological and ecological limitations: as a species it permanently develops new potentials, and as an individual, it depends on other individuals, i.e. on the genotype and the external forces, so it often cannot survive. The presented data on morphophysiological and other characters can be significant for the suppression of the undesired invasion and for the amorpha breeding. In the past, it was thought that these phenomena belonged to the sphere of ecology, but they do deserve a much greater attention by herbologists than in previous studies.

Table 1. - Biological characteristics of amorpha in the populations in Serbia

Property	Characteristics	References
Stand type	Linear-multidimensional	4,6,10
Growth	Fast	6,10
Development	Fast	6
Secondary range	Cultigeneous, subspontaneous	4,6,10
Flowering	Abundant	6,8
Induced neoteny	Tree cutting	8,11
Fructification	Very abundant	6,9
Second fructification	Rare and poor	6,9
Xenogamy	Dominant	3,6
Autogamy	Rare or induced	3,6
Variability	Individual, population	3,6,7,8
Vitality	Very high	3,6

Table 2. - Types of amorpha (Amorpha fruticosa L.) adaptation

1. Ontogenetic adaptation
2. Population adaptation
3. Phylogenetic adaptation

Table 3. - The scheme of the hypothetical model of the transformation of genetic programs and gene expressions in the tree ontogenesis, modified after several authors

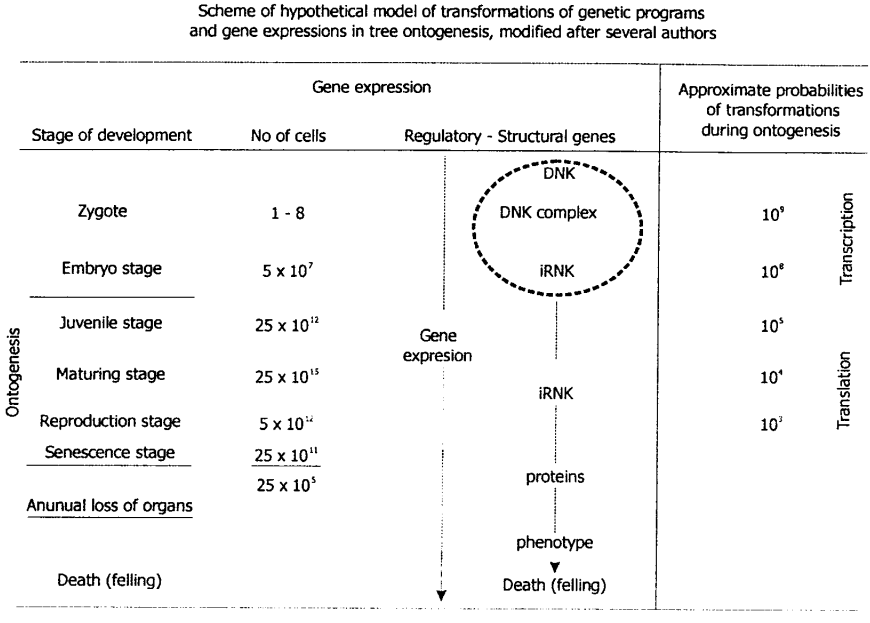
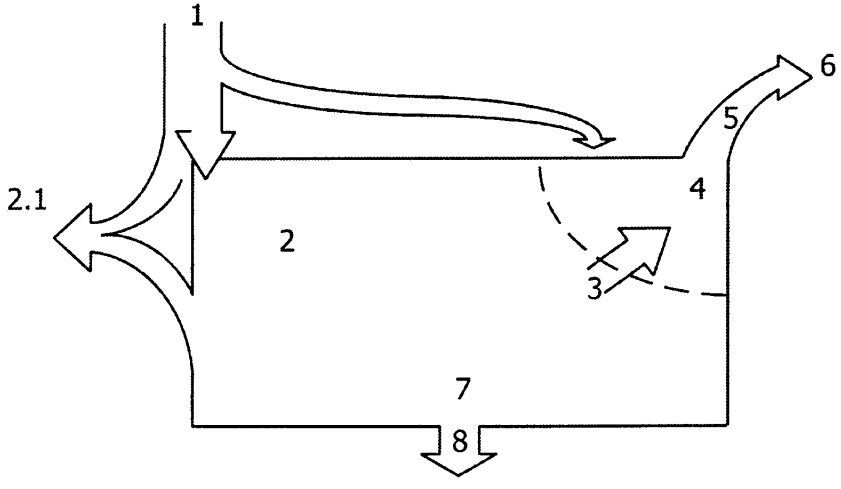
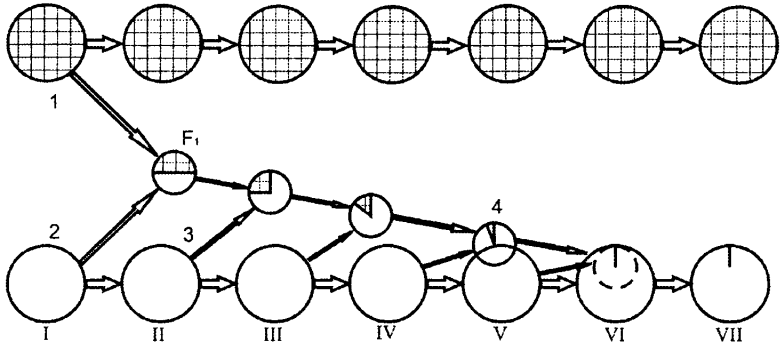


Table 4. - The types of chlorophyl mutations of seedlings (after Kalam and Orava, 1974) in 4 (2,4,6 and 9) of 12 half-sib lines of amorpha

Half-sib lines	Group and subgroup	Type	Symbol
2,4,9	I group		
	atroviridis-dark green	glauca,viridisima,	glau,virid
	viridis-light green	flavoviridis,chlorotica,	flavi, chloti
	xantha-yellow	aurea,lutea	au,lut
	II group	punctata,	pu,
	maculata-spotted	viridomaculata,	vimac,
	tirgina-transversely striped	xanthotigrina,	xatig,
	apicaulis-apexes coloured	xanthoviridis,	xavi,
2,6	**marginata**-leaf margins coloured	xanthoalbina, viridomaculata,	xaal, vimarg,
	costata-nerves cloured	xanthomarginata, viridocostata	xamarg, vivis
	III group		
	lutescens-green plants are transformed into yellow	viridolutescens	vilutis



Scheme 1. - Conceptual model of the genetic seed (fruit) bank and initiation of amorpha population index (1. seed dispersal; 2. genetic bank of dormant seed; 2. 1. floatin seed; 3. stimuli; 4. bank of active seed; 5. germination; 6. seedlings; 7. dormancy and ageing; 8. dying;)



Scheme 2. - Diagram of intrapopulation crossing of var. fruticosa and var. angustifolia trees, followed by back crossing with var. angustifolia (2) with gradual loss of var. fruticosa genes (1)

CONCLUSION

Amorpha stability, competitiveness, i.e. invasion capacity result from three levels of adaptation: ontogenetic, population and phylogenetic. As the processes of adaptation are simultaneous, there is a special-specific criterion of adaptation for each of the three levels. The adaptation depending on the stage of development was not taken as significant until it was understood that an individual is exposed to natural selection in each phase of its life cycle. The significance of the levels led to the design of the model of tree-shrub ontogenesis. The effect of pod dispersal and individual variability on the dynamics of amorpha populations was observed by the study of populations. The third phylogenetic level of adaptation, by the successive generations, has a decisive role in the amorpha evolution. Consequently, it is the general potential of adaptation that characterises the invasion capacity of amorpha as a species. In the past, it was thought that these phenomena belonged to the sphere of ecology, although they deserve much greater attention.

REFERENCES

GOLOVKIN, N.B. (1988): Kultigeni areal rastenii. Izd. Nauka. Moskva.

HERPEK, J.L. (1977): Population biology of plants. London, New York, 892.

IVETIĆ, V., TUCOVIĆ, A. (2003): Efekti samooplodnje na cvasti, cvetove, seme i klijavce bagrenca. Zbornik abstrakata II simpozijuma za oplemenjivanje organizama, Vrnjačka Banja, 121.

PETRAČIĆ, A. (1938): *Amorpha fruticosa* L. kao nov i opasan korov u posavskim šumama. Šumarski list, Zagreb, 623-626.

TUCOVIĆ, A. (1994): Geneticki aspekti primene herbicida u šumskim rasadnicima. Acta herbologica, 3(2): 17-24.

TUCOVIĆ, A., ISAJEV, V. (2000): Kolonizacija šumskog staništa žbunovima *Amorpha fruticosa* L. u Srbiji i njene biološke osobine. Acta herbologica, 8(1): 43-54.

TUCOVIĆ, A., ISAJEV, V. (2000): Karakteristike i varijabilnost klijavaca bagrenca (*Amorpha fruticosa* L.).

TUCOVIĆ, A. (2001): Inducend neoteny of Amorpha schoots and its significance. Acta herbologica, 10(1): 93-100.

TUCOVIĆ, A., VILOTIĆ, D. (2001): Repeated fructification of Amorpha (*Amorpha fruticosa* L) seedlings survival and characteristics. Acta herbologica, 10(1): 49-58.

TUCOVIĆ, A., ISAJEV, V., ŠIJAČIĆ-NIKOLIĆ, M. (2003): Secondarz range and ecophysiological characteristics of Amorpha fruticosa L. in Serbia. Third International Balcan Botanical Congress. Book of abstract, P.41.

TUCOVIĆ, A., ISAJEV, V. (2003): analiza faktora od znacaja za indukovanje prvog cvetanja bagrenca. XV simpozijum JDFB. Vrdnik, Izvodi iz saopštenja, 121.

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UZROCI INVAZIJE CIVITNJACE (*AMORPHA FRUTICOSA L.*) NA ŠUMSKA STANIŠTA SRBIJE

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Izvod

Sposobnost subspontanog naseljavanje biljaka na nova staništa i njihovo prodiranje u sastav domaćih biljnih zajednica označava se kao invazija biljaka. Invazija drveća i žbunja u šumske zajednice je retka pojava u nas i zahteva posebna istraživanja u cilju njihovog suzbijanja ili oplemenjivanje. Kao objekat odabrane su gajene sastojine i subspontane populacije u cenozama drveća i žbunja u Srbiji. Ocenjivana je promenljivost morfofizioloških osobina na nivou stabala, populacija i vrste kao celine. U stacionarnim sastojinama i ogledima premeravana su i statistički analizirana kvantitativna svojstva stabala i linija polusrodnika.

Stabilnost, konkurentnost tj. invaziona sposobnost civitnjace rezultat su postojanja tri nivoa adaptibilnosti: ontogenetske, populacione i filogenetske. Kako se proces adaptacije obavlja na više nivoa postoji za svaki od nivoa posebanspecifičan kriterijum adaptibilnosti. Uzrasna adaptibilnost nije bila od značaja sve dok se nije shvatilo da je jedinka izložena prirodnom odabiranju (borba za opstanak, selektivna prednost i dr.); značajan nivo uslovio je intenzivnu aktivnost na izradi modela ontogeneze drveća-žbunja. Izučavanjem populacija uočen je uticaj rasturanja jednosemenih mahuna kao i promenljivost individua na dinamičnost populacija. Treći, filogenetski nivo adaptacije, preko sukcesivnih generacija, ima odlučujuću ulogu u evoluciji civitnjace. Stoga se može govoriti o opštem potencijalu adaptivnosti koji karakteriše sposobnost civitnjace kao vrste. Invaziona sposobnost civitnjace ne može se shvatiti bez izvesnih imanentnih suprotnosti: stalno prevazilaženje genetičko-fizioloških i ekoloških ograničenja: kao vrsta stalno razvija nove potencije, a kao jedinka je zavisna od drugih jedinki, tj. od genotipa i spoljašnjih sila, te često ne može da opstane - preživi. Izneti podaci u prilozima mogu biti od značaja za suzbijanje i oplemenjivanje civitnjace u nas. U prošlosti se smatralo da ove pojave spadaju u delokrug ekologije mada one zaslužuju veću pažnju herbologa nego što su je do sada dobile.

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