

AGAT - A NEW EARLY SOYBEAN CULTIVAR WITH HIGH INSERTION OF BASAL PODS

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ABSTRACT

A new early cultivar - Agat - with high insertion of the basal pods is presented. It was created at the Turda Agricultural Research Station and registered in 1998. The new cultivar is characterized by a growing season adequate to the ecological conditions of zone, a high production potential as compared to the maturity group to which it belongs, a very high resistance to lodging, shattering and mildew, and a high resistance to bacteriosis. The Agat cultivar is also remarkable for its high protein and oil content. The essential new feature of this cultivar is the height (21 cm) of the basal pod insertion, a character which ranks it at a higher level as compared to the other cultivars used so far. The achieved yield increase, as compared to the Diamant and Perla cultivars, as well as the increased insertion height of the new Agat cultivar emphasizes the genetic progress achieved in the two directions.

Key words: pod insertion, soybean, symbiosis

INTRODUCTION

Within the group of grain legumes, the soybean, by its protein and oil content, is particularly superior as compared to both the other grain legumes and cereals. Due to its symbiotic relation with the bacteria of the *Rhizobium* genus, the soybean contributes to accumulate in soil up to 80-100 kg N/ha. The soybean, used as a previous crop for winter cereals, only by symbiosis effect, supplies free of charge, a large part of the nitrogen needed for wheat and barley (Soare and Dencescu, 1998).

Due to its particular value, the soybean has multiple uses, beginning with the animal feeding and going on with using it for various dietetic culinary food and as raw material for food, chemical and pharmaceutical industries.

In spite of its value and multiple possibilities to be used, since 1989 the land area cultivated in Romania with soybean has alarmingly decreased. If, in 1989, the soybean was cultivated on 512200 ha, the land area cultivated with soybean substantially decreased reaching only 58418 ha in 1997 (Statistic Yearbook of Romania, 1991). However, a positive phenomenon should be mentioned for this period - the increase of the average yield per hectare, from 593 kg/ha in

1989 to 1400 kg/ha, recorded in the last 5 years (Anonymous, 1997). It seems that we shall have to do with the reenhancement of this crop, a proof being also the practical doubling of the soybean crop area in 1998, reaching 27845 ha.

Having in view that the Transylvania Plain represents one of the most suitable zones for growing soybean (Tîmpeanu et al., 1992), that we have a biological material adapted to the ecological conditions of this area as well as performant cropping technologies specific to each cultivar, we consider that it is possible to reenhance this crop in the same zone.

The soybean cultivars suitable for the Transylvania Plain and the Western Plain are presented in the table 1.

Table 1. Soybean cultivars for Transylvania Plain

Cultivar	Certification (year)	Source
Diamant	1987	A.R.S. Turda
Perla	1994	A.R.S. Turda
Agat	1998	A.R.S. Turda
Atlas	1986	R.I.C.I.C. Fundulea
Ilfov	1989	U.A.S.V. M. București
Evans	1979	U.S.A.

The Agat cultivar is the most recent creation of the Turda Agricultural Research Station in the field of the early soybean breeding, and this paper presents the main characteristics and features of the new cultivar.

MATERIALS AND METHODS

The new Agat cultivar, having as genitors the Evans American cultivar and the THI source, was obtained by crossing followed by individually repeated selection.

RESULTS

Morphological characteristics

The main morphological characteristics of the new Agat cultivar, as compared to the Diamant and Perla cultivars, are presented in table 2.

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Table 2. Main morphological characteristics of Agat cultivar as compared to Perla and Diamant cultivars

Characteristics	Cultivars		
	Agat	Perla	Diamant
PHENOTYPE			
Form of plant aerial part	compact	compact	compact
Plant stem	erect	erect	erect
Growing type	semidetermined	semidetermined	semidetermined
Plant height (cm)	107 (101-118)	87 (74-105)	87 (76-101)
Insertion height (cm)	21 (18-23)	11 (9-13)	9 (7-10)
Pubescence	grey	reddish	reddish
LEAF			
Form of leaflets	ovoid	ovoid, pointed	ovoid
Colour of leaflets	light green	strongly green	gray-green
INFLORESCENCE			
Colour of flower	white	violet	violet
Fruit			
Colour at maturity	light brown	light brown	brown
GRAIN			
Form	ovoid	ovoid	spherical-flattened
Colour	yellow	yellow	yellow
Colour of hilum	light brown	dark brown	black
Mass of 1000 grains (g)	176 (166-183)	162 (150-170)	173 (164-186)

The new cultivar is characterized by a compact brushy growing, an erect stem and a semidetermined growing. The Agat cultivar is a tall plant as compared to the Diamant and Perla cultivars which have a moderate height. The average height of the basal pod insertion is of 21 cm, clearly higher than the height of the other commercial cultivated cultivars used at present. Its gray pubescence is a characteristic by which the Agat cultivar is easily distinguished, during the growing season, from the Diamant and Perla cultivars whose pubescence is reddish. The white colour of flower is another characteristics by which the Agat cultivar is easily distinguished, during the growing season, from the other soybean cultivars created at Turda whose flower is violet. When matured, the pods are light brown. The grain is ovoidal, yellow, with a light brown hilum. The hilum colour is an important characteristic by which, at maturity, the Agat cultivar may be distinguished from the Diamant and Perla cultivars whose hilum is black, brown, respectively. The mass of 1000 grains is, on an average, 176 g, close to that of the Diamant cultivar.

Physiological characteristics

The Agat cultivar is characterized by a very high resistance to lodging and shattering features, which corroborated with the high

insertion of the basal pods, ensures very good conditions for mechanized harvest with the combine.

The new cultivar is characterized also by a very high resistance to bacteriosis (*Pseudomonas glycinae*), being, under this aspect, higher than the Diamant, Atlas and Ilfov cultivars and by a high resistance to mildew (*Peronospora manshurica*).

The Agat cultivar has a growing season very close to the growing season of the Perla cultivar. The season growing of 125 days of this cultivar ranks it within the needs of zone, thus constituting also a good previous crop for the winter cereals (Table 3).

Production capacity

The new Agat cultivar is also characterized by a good production capacity.

The average yield obtained in 1994-1997, at the Turda Agricultural Research Station, was 2660 kg/ha, with variations between 2590 and 3070 kg/ha, exceeding with 18 per cent the Diamant cultivar and 5.3 per cent the Perla cultivar (Table 4).

As compared to the cultivars recommended for the Transylvania Plain zone, the Agat cultivar reached higher yields exceeding the Atlas cultivar with 25.3 per cent, the Ilfov cultivar with 29.4 per cent and the Evans cultivar with 18.7 per cent. Besides the

Table 3. Physiological features of Agat cultivar as compared to Perla, Diamant, Atlas, Ilfov and Evans cultivars. A.R.S. Turda, 1994-1998

Features	Item	Cultivars					
		Agat	Perla	Diamant	Atlas	Ilfov	Evans
Resistance to:							
- lodging	mark ¹⁾	1.0	1.0	1.0	1.0	1.6	1.2
- shattering	mark ¹⁾	1.0	1.0	1.0	1.0	2.0	1.0
- <i>Pseudomonas glycinae</i>	mark ¹⁾	1.8	1.8	2.6	3.2	2.4	2.0
- <i>Peronospora manshurica</i>	mark ¹⁾	1.3	1.3	1.0	1.4	1.6	1.4
GROWING SEASON	days	125	122	119	127	124	130

¹⁾Note: (1-9): 1 = very resistant
9 = very sensitive

Table 4. Agat cultivar yield as compared to Diamant and Perla cultivars. A.R.S. Turda, 1994-1997

Cultivars	Average yield kg/ha	Variation limits kg/ha	Relatively yield as compared to:				Increase %
			Diamant		Perla		
			%	signif.	%	signif.	
Diamant	2430	2260-2570	100.0	control	89.2	00	5.6
Perla	2720	2540-3070	112.1	xx	100.0	control	8.7
Agat	2860	2590-3070	118.0	xx	105.3	-	7.5
	LSD 5%		7.9		7.1		
	LSD 1%		11.9		10.7		
	LSD 0.1%		19.3		17.2		

Table 5. Agat cultivar yield as compared to Atlas, Ilfov and Evans cultivars. A.R.S., Turda, 1994-1997

Cultivars	Average yield kg/ha	Variation limits kg/ha	Relatively yield as compared to:						Increase %
			Atlas		Ilfov		Evans		
			%	signif.	%	signif.	%	Signif.	
Agat	2860	2590-3070	125.3	xx	129.4	xxx	118.7	xx	7.5
Atlas	2290	1940-2620	100.0	control	103.3		94.7		12.2
Ilfov	2210	2040-2300	96.8		100.0	control	91.7	-	5.3
Evans	2410	2120-2600	105.6		109.1		100.0	control	9.4
	LSD 5%		13.0		13.4		12.3		
	LSD 1%		18.7		19.3		17.7		
	LSD 0.1%		27.5		28.4		26.1		

good production capacity, the new Agat cultivar is characterized also by a high stability of yield (Table 5).

In the testing period (1994-1996) within the network of the State Institute for Cultivar Testing and Registering, the Agat cultivar, as compared to the Diamant cultivar, achieved on an average, a yield increase of 10 per cent. In all the centres, the yield increase varied between 1 per cent at Negre^oti and 18 per cent at Inand and Satu Mare centres. At Galda and Ludu^o centres, the Agat cultivar exceeded the Diamant cultivar with 7 per cent. It should be mentioned the high yields reached at the Satu Mare and Ludu^o centres of 2970 kg/ha and 2810 kg/ha, respectively (Figure 1).

As compared to the Atlas cultivar, in the same period, the new cultivar achieved, on an

average a yield increase of 8 per cent, in all the centres the yield increase varying between 2 per cent at Negre^oti and Inand, and 14 per cent at Satu-Mare. It should be also mentioned the yield increase of 12 per cent obtained at the Galda centre (Figure 2).

Insertion height

The insertion height of the basal pods is the most important characteristic of the Agat cultivar, a feature that makes it superior as compared to the other cultivars grown so far.

The commercial cultivars grown at the present are characterized by a low enough insertion of the basal pods that makes the yield losses reach up to 220 kg/ha on the near level lands and 660 kg/ha on the lands with a slope of 12 per cent (Ardeleanu, 1976, 1979).

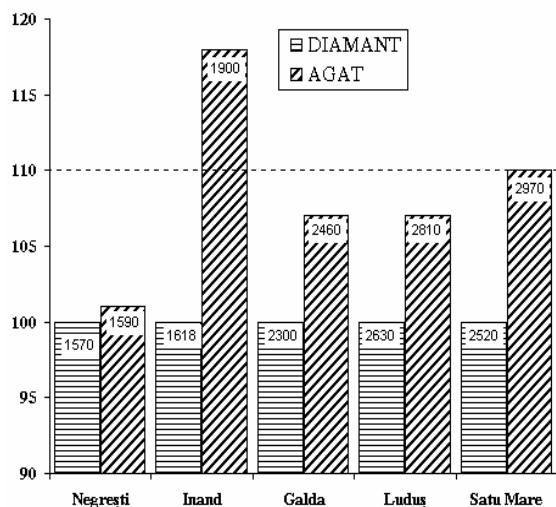


Figure 1. Agat cultivar yield as compared to Diamant cultivar in S.I.C.T.R.s network (1994 – 1996)

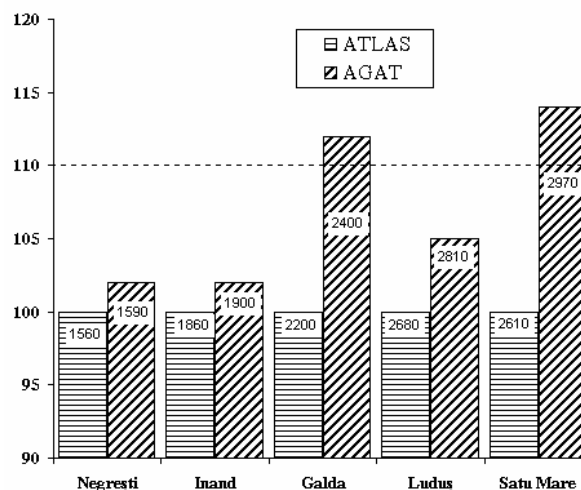


Figure 2. Agat cultivar yield as compared to Atlas cultivar in S.I.C.T.R.s network (1994 – 1996)

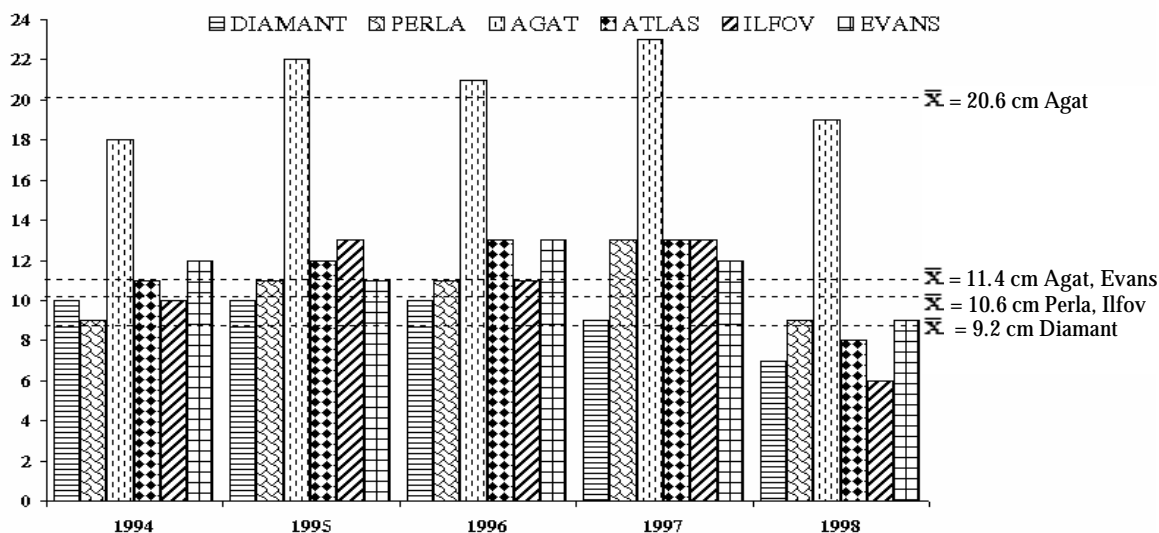


Figure 3. Height of Agat cultivar insertion as compared to other cultivars recommended for Transylvania Plain

By cultivation of the Agat cultivar, these losses are avoided due to the high pod insertion whose value was, in 1994-1998, of 20.6 cm, a height superior as compared to the average insertion heights of the Diamant (9.2 cm), Perla and Ilfov (10.6 cm), Atlas and Evans (11.4 cm) cultivars (Figure 3).

Qualitative features

The Agat cultivar is also characterized by higher qualitative features reaching, on an average, in 1994-1997, a protein content of

39.3 per cent, practically, at the same level of the Diamant and Evans cultivars and little higher than the Ilfov cultivar. As concerns the oil content, it realized, on an average, 19.8 per cent, a content close to the majority of the other cultivars (Table 6).

Analysing the protein and oil yield/ha, it should be observed that, by its 970 kg protein/ha and 487 kg oil/ha, the Agat cultivar exceeded all the other cultivars recommended for this zone, which were compared with this cultivar (Table 7).

Table 6. Protein and oil content of Agat cultivar as compared to Diamant, Perla, Ilfov and Evans cultivars

Cultivars	Protein content (%)		Oil content (%)	
	Average 1994-1997	Variation limits	Average 1994-1997	Variation limits
Agat	39.3	37.5-40.5	19.8	18.7-20.4
Diamant	39.4	36.8-41.8	20.0	19.4-20.4
Perla	40.0	38.9-41.1	20.4	19.1-21.3
Ilfov	38.9	37.6-41.0	20.3	19.1-21.7
Evans	39.7	38.9-40.4	20.7	20.3-21.8

Table 7. Protein and oil yield/ha of Agat cultivar as compared to Diamant, Perla, Ilfov and Evans cultivars

Cultivars	Protein yield		Oil yield	
	Average 1994-1997 kg/ha	Increase %	Average 1994-1997 kg/ha	Increase %
Agat	970	10.1	487	7.9
Diamant	823	9.0	416	4.0
Perla	937	9.7	476	10.5
Ilfov	740	7.5	386	6.7
Evans	824	9.1	430	8.8

General characterization

For a synthetical, global characterization of the Agat cultivar, it was necessary to have a graphical representation of the main characteristics and features of the new cultivar as compared with those of the Diamant, Perla and Atlas, the most important cultivars for this zone.

The comparison between the Agat cultivar and the Diamant cultivar shows the obvious superior level of the Agat cultivar regarding the production capacity, plant height of

the basal pods, protein and oil yield per hectare and the resistance to the bacteriosis. Both cultivars are very resistant to lodging and shattering, and very close concerning their resistance to the mildew (Figure 4).

The comparison between the Agat cultivar and the Perla cultivar shows that the new cultivar is superior regarding the yield/ha, the height of plant and insertion, protein and oil yield/ha. The two cultivars are very close concerning the growing season and equal regarding the resistance to lodging, shattering,

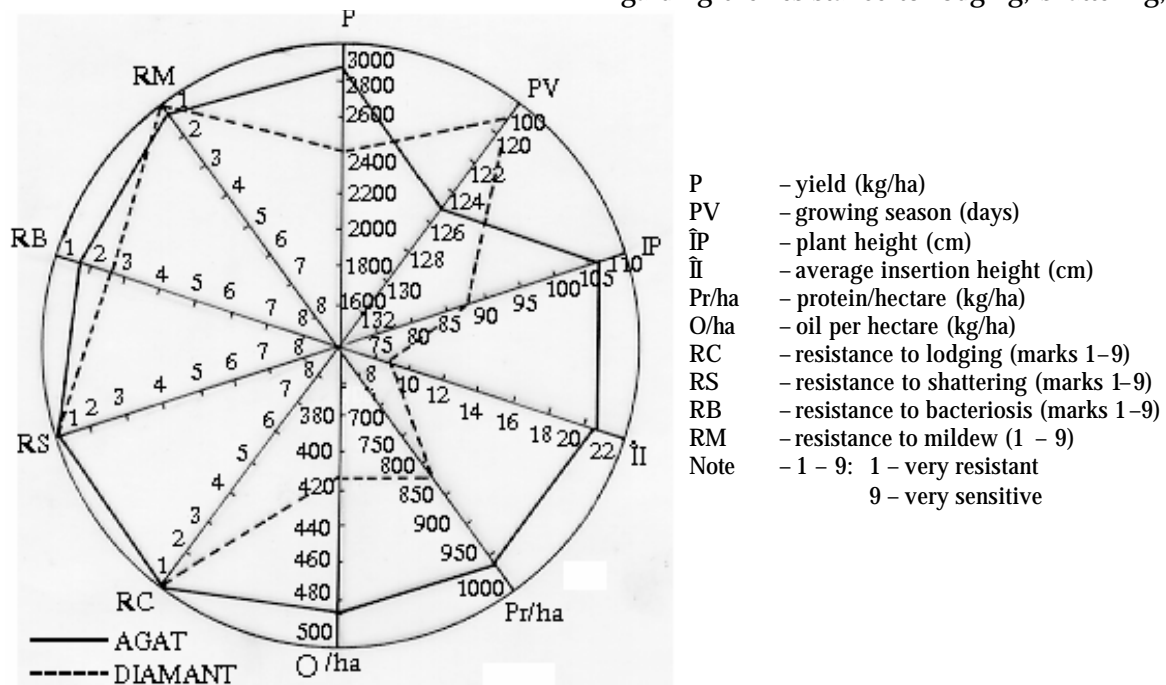


Figure 4. Graphic representation of main characteristics and features of Agat cultivar as compared to Diamant cultivar

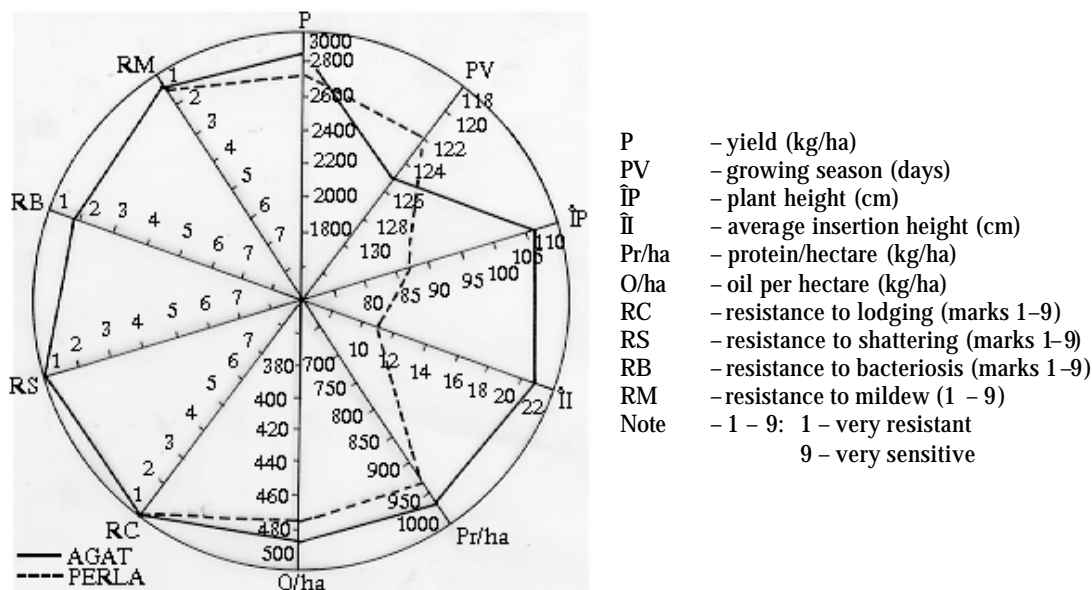


Figure 5. Graphic representation of main characteristics and features of Agat cultivar as compared to Perla cultivar

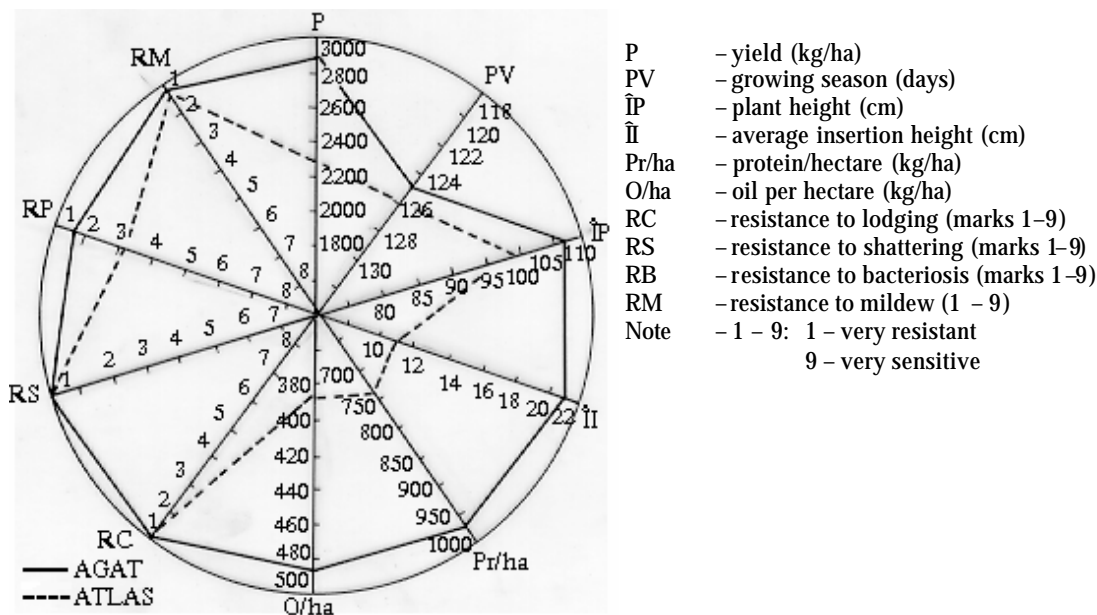


Figure 6. Graphic representation of main characteristics and features of Agat cultivar as compared to Atlas cultivar

bacteriosis and mildew, both being very resistant (Figure 5).

The comparison between the Agat cultivar and the Atlas cultivar, excepting the resistance to lodging and shattering, where both are equal, being very resistant, shows the obviously superior level of the Agat cultivar regarding all the other characteristics (Figure 6).

CONCLUSIONS

The new Agat cultivar is remarked by the growing season adequate to requirements of the zone, the very high production potential as compared to the maturity group in which it is included and the higher qualitative features.

Its very high resistance to lodging and shattering, corroborated with high insertion of the basal pods which is at a superior level

as compared to the other cultivars, practically avoids the harvest losses.

The characteristics and features of the Agat cultivar recommend it as the most adequate cultivar for the Transylvania Plain, north-eastern Moldavia and West Plain of Romania.

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Table 1
Soybean cultivars for Transylvania Plain

Cultivar	Certification (year)	Source
DIAMANT	1987	S.C.A. Turda
PERLA	1994	S.C.A. Turda
AGAT	1998	S.C.A. Turda
ATLAS	1986	I.C.C.P.T. Fundulea
ILFOV	1989	U.S.A.M.V. Bucure ^o ti
EVANS	1979	S.U.A.

Table 2
Main morphological characteristics of AGAT cultivar as compared to PERLA and DIAMANT cultivars

Characteristics	Cultivar AGAT	PERLA	DIAMANT
STRAIN			
Form of plant aerial part	compact	compact	compact
Plant stem	erect	erect	erect
Growing type	semidetermined	semidetermined	semidetermined
Plant height (cm)	107 (101-118)	87 (74 - 105)	87 (76- 101)
Insertion height (cm)	21 (18-23)	11 (9-13)	9 (7-10)
Pubescens	grey	reddish	reddish
LEAF			
Form of leaflets	ovoid	ovoid, pointed	ovoid
Colour of leaflets	light green	strongly green	gray-green
INFLORESCENCE			
raceme	raceme	raceme	raceme
Colour of flower	white	violet	violet
Fruit			
Colour at maturity	light brown	light brown	brown
GRAIN			
Form	ovoid	ovoid	spherical-flattened
Colour	yellow	yellow	yellow
Colour of hilum	light brown	dark brown	black
Mass of 1000 grains (g)	176 (166-183)	162 (150-170)	173 (164-186)

Table 3
Physiological features of AGAT cultivar as compared to PERLA, DIAMANT, ATLAS, ILFOV and EVANS cultivars (A.R.S. Turda, 1994-1998)

Feature	Item	Cultivar	PERLA	DIAMANT	ATLAS	ILFOV	EVANS
RESISTANCE TO:		AGAT					
- lodging	mark ¹⁾	1.0	1.0	1.0	1.0	1.6	1.2
- shattering	mark ¹⁾	1.0	1.0	1.0	1.0	2.0	1.0
- Pseudomonas glycinae	mark ¹⁾	1.8	1.8	2.6	3.2	2.4	2.0
- Peronospora manshurica	mark ¹⁾	1.3	1.3	1.0	1.4	1.6	1.4
GROWING SEASON	days	125	122	119	127	124	130

¹⁾ Note: (1-9): 1 = very resistant
 9 = very sensitive

Table 4
AGAT cultivar yield as compared to DIAMANT and PERLA cultivars (R.S. Turda 1994-1997)

Cultivar	Average yield (kg/ha)	Variation limits (kg/ha)	Relatively yield as compared to:				Increase %
			DIAMANT %	Signif. control	PERLA %	Signif. control	
DIAMANT	2430	2260-2570	100.0		89.2	00	5.6
PERLA	2720	2540-3070	112.1	xx	100.0	control	8.7
AGAT	2860	2590-3070	118.0	xx	105.3	-	7.5
LSD 5%			7.9		7.1		
LSD 1%			11.9		10.7		
LSD 0.1%			19.3		17.2		

Table 5
Agat cultivar yield as compared to ATLAS, ILFOV and EVANS cultivars (A.R.S., Turda, 1994-1997)

Cultivar	Average yield (kg/ha)	Variation limits (kg/ha)	Relatively yield as compared to:						Increase %
			ATLAS %	Signif.	ILFOV %	Signif.	EVANS %	Signif.	
AGAT	2860	2590-3070	125.3	xx	129.4	xxx	118.7	xx	7.5
ATLAS	2290	1940-2620	100.0	control	103.3		94.7		12.2
ILFOV	2210	2040-2300	96.8		100.0	control	91.7	-	5.3
EVANS	2410	2120-2600	105.6		109.1		100.0	control	9.4
LSD 5%			13.0		13.4		12.3		
LSD 1%			18.7		19.3		17.7		
LSD 0.1%			27.5		28.4		26.1		

Table 6

Protein and oil content of Agat cultivar as compared to Diamant, Perla, Ilfov and Evans cultivars

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PERLA	40.0	38.9-41.1	20.4	19.1-21.3
ILFOV	38.9	37.6-41.0	20.3	19.1-21.7
EVANS	39.7	38.9-40.4	20.7	20.3-21.8

Table 7

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