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Delayed harvesting of soybean: effects on pod shattering and seed germination

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Abstract

Four soybean varieties MG 00, 0, I and II were planted in field experiment during 1994 and 1995. Influence of delayed harvesting on pod shattering and seed germination were investigated. Unfavorable conditions (high temperature during reproductive period and a small amount of rainfall) caused poorer seed quality, higher shattering, more excessive losses in germination with later harvesting. Considering pod shattering, it begins the second week after maturation in early varieties Ranka and Panonka, and in the third week for later varieties Balkan and Vojvodjanka, increasing rapidly, particularly under unfavourable conditions.
Declined germination ability was observed in all varieties in both years, but it is stronger in early varieties under unfavourable conditions. Regression coefficients in 1994 and 1995 for the variety Ranka were b = -1.02 and b = -0.43, for Panonka b = -0.33 and b = -0.40, for Balkan b = - 0.50 and b = -0.07 and for Vojvodjanka b = -0.52 and b = -0.01.

Keywords: Soybean, pod shattering, seed germination.

Introduction

Particular plant density should be provided for a successful soybean production. The desired density can be achieved by high quality seed that germinates uniformly. It happens sometimes that due to weather conditions, soybean harvesting is not performed timely, in the maturation phase (R8), but later on. Sometimes, it is awaited for already matured crop to dry in field, reducing thus drying expenses (Chen et al., 1986). Many studies have examined influence varying lengths of time after maturation on pod shattering and seed germination. Philbrook (1989) found that the losses increase with later harvest and net yields were reduced at a rate of 11 kg/ha/day. Reis et al., (1989) showed that increased time in the field was directly related to reduced germination capacity. Jain et al (1989) found out that some varieties showed smaller decreases in yield due to shattering than other. The objective of the investigation was to study the effect of delayed harvesting on the losses due to pod shattering and on seed germination of the varieties of various maturity groups.

Material and Methods

Field studies were conducted in 1994 and 1995 at Rimski Šanèevi, Institute of Field and Vegetable Crops, Novi Sad. The varieties used in this study, Ranka, Panonka, Balkan, and Vojvodjanka belong to the maturity groups 00, 0, I and II, respectively.

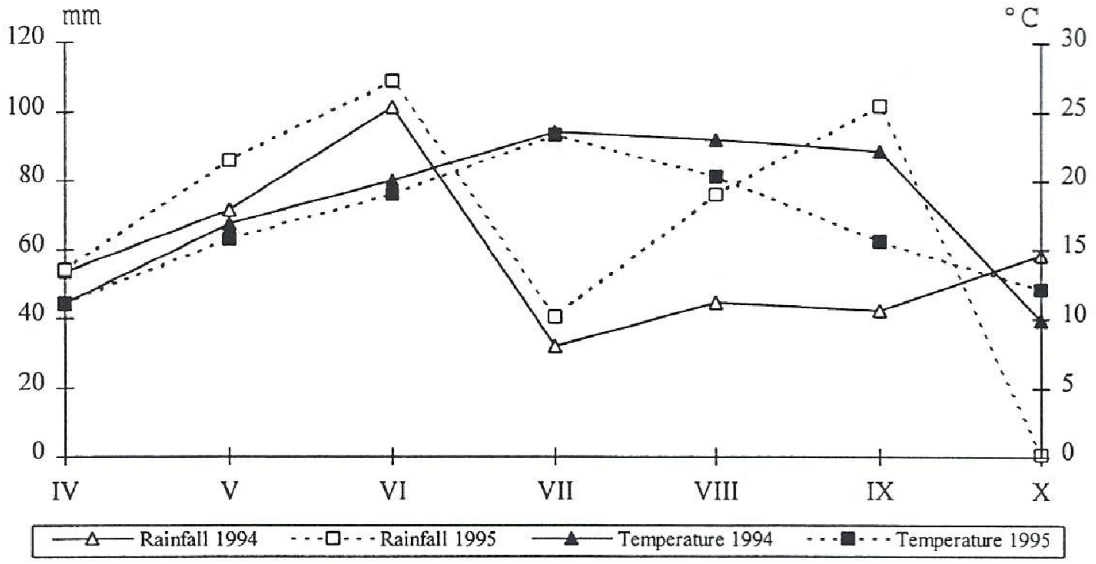


Figure 1. Temperature (monthly mean, °C) and rainfall (monthly total, mm) in vegetation season in 1994 and 1995.

The experiment was carried out in Completely Randomized Block Design (RCBD) in four replications. The plots were composed of eight rows, five meters long and 50 cm apart. Half of every plot was harvested by combine in R8 stage (Fehr and Caviness, 1977). Percent of pod shattering was established by counting shattered pods on the plants from the second half of every plot. Twenty plants were sampled per replication. The process was repeated every seventh day, to Oct. 28, 1994, i.e., Oct. 19, 1995. The seed was air dried. 100-seed mass was measured (2 x 100 seeds per replication for each variety). Seed germination was tested on sand at 25^{o}C (4 x 100 seeds for each variety). The data were processed using regression analysis method according to Ezzekiel and Fox (1970).

The data on temperature and precipitation were obtained from the meteorologic station at Rimski Šanèevi (Figure 1).

Results and Discussion

Temperature and rainfall sum during the two years of the study varied significantly (Figure 1) particularly in reproductive period, which affected the length of growing period, yield and seed quality. Due to high temperatures and low amounts of rainfall in July and August (R5-R7), the growing period was shorter in 1994, the seed was smaller and yields lower than in 1995, when temperatures and precipitation were very favourable for soybean production (Table 1).

Variation coefficient for 100-grain mass was low in both years of the study, varying from 3.20% to 5.35% in 1994 and from 2.45% to 5.31% in 1995. However, in 1994, the seed was much smaller, particularly in late-maturing varieties (Table 1).

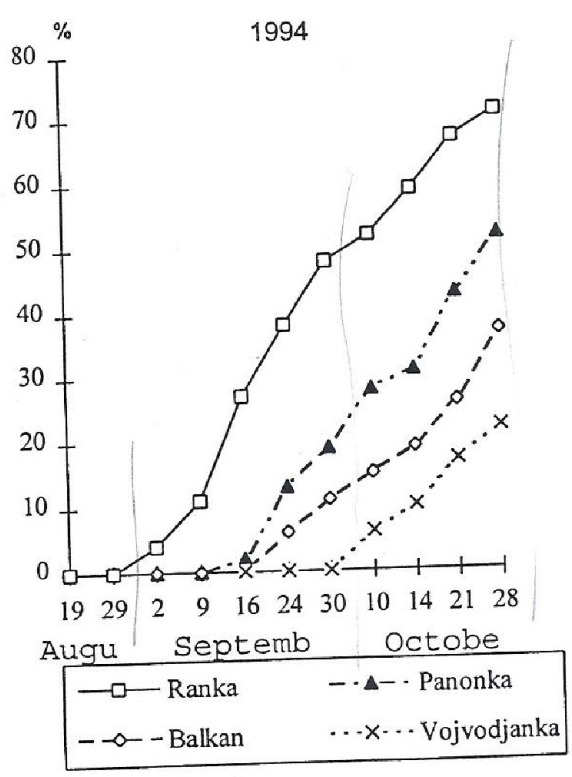
Unfavourable weather conditions affected yield in 1995 less than in 1994. Drought and high temperatures during reproductive period had

Table 1 - Vegetation period, 100 grains mass, and yield of investigated varieties in 1994 and 1995.

Year	Variety	MG	Days from sowing		100 grain mass (g)	Variation coefficient (%)	Yield (kg/ha)
			Germination	Maturity			
1994	Ranka	00	11	128	15.2	3.20	3377
1994	Panonka	0	11	141	13.4	3.64	3517
1994	Balkan	I	11	144	13.7	4.37	3725
1994	Vojvodjanka	II	11	156	10.9	5.35	3460
1995	Ranka	00	12	140	19.9	2.45	6058
1995	Panonka	0	12	154	20.7	5.31	6221
1995	Balkan	I	12	160	25.2	3.15	6385
1995	Vojvodjanka	II	12	164	17.5	3.52	6537

significant influence on germination (Heatherly, 1993). Only 30 mm of rainfall in July and 40 mm at the end of the August in 1994 (Figure1) caused water stress during seed filling period which results in lower yields and seed germination.

In 1994, pod shattering rate was higher in all varieties. Comparing late and early-maturing varieties, pod shattering was higher in the former one than in the latter (Figure 2). In 1994, pod shattering started in the second week after the



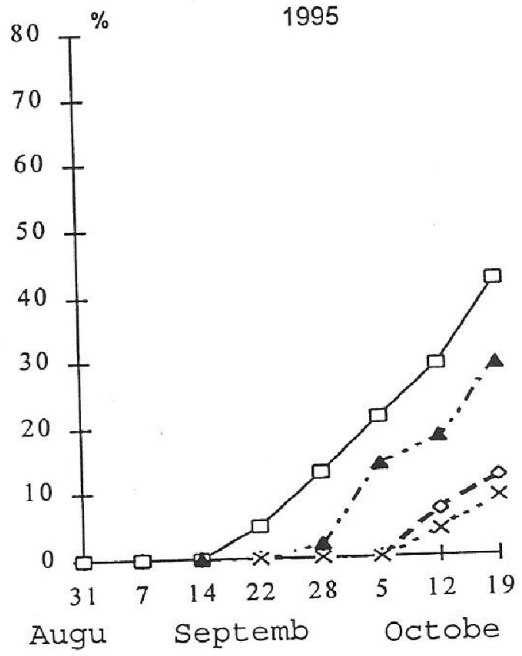


Figure. 2. Pod shattering of the varieties of various maturity groups in 1994 and 1995

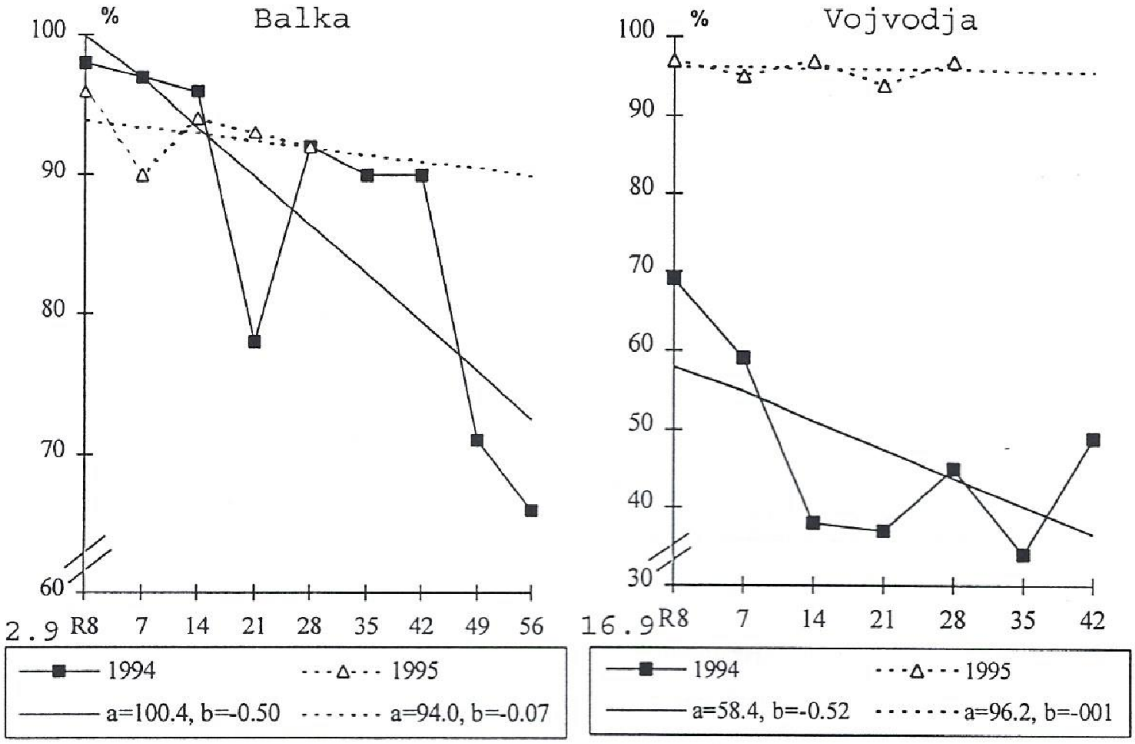


Figure 3. Percent of germination of soybean varieties in 1994 and 1995

beginning of ripening in the varieties Ranka and Panonka and in the third week in the varieties Balkan and Vojvodjanka. Three weeks after ripening, early varieties had more than 10% of cracked pods, which increased later on increasing yield losses. Pod shattering is slower in the varieties Balkan and Vojvodjanka, but in the case of delayed harvesting, the percent of cracked pods increased. In 1995, pod shattering was weaker, particularly in late-maturing varieties. However, delayed harvesting also increased pod shattering.

Seed germination of all studied varieties declined with late harvesting in 1994 (Figure3). That is particularly clear for the variety Ranka, as every delayed day declined germination for one percentage (b=-1.02). Considering other varieties, germination decline was lower (b=-0.33 for Panonka, b=-0.50 for Balkan and b=-0.52 for Vojvodjanka), but the initial germination of Panonka and Vojvodjanka is very low, about 70%. In 1995, the best germination was registered for the variety Vojvodjanka, and delayed harvesting had no effect on germination (b=-0.01). Low decline in germination was registered for the variety Balkan (b=-0.07), while other varieties expressed higher decline in germination with delayed harvesting (b=-0.43 for Ranka and b=-0.40 for Panonka).

Bearing in mind the fact that pod shattering is higher in these varieties, the losses due to late harvesting are very high.In both years, the best germination was registered for the variety Balkan, which is the least susceptible variety to delayed harvesting.

Conclusion

Seed quality depends on weather conditions during seed formation. Under unfavourable conditions, such as high temperatures and drought, there comes to forming of small seeds of poor quality. Such seeds unevenly emerge and reduce number of plants per ha, which altogether cause decrease in yields. Pod shattering starts in the second week after ripening in the varieties Ranka and Panonka and in the third week in the varieties Balkan and Vojvodjanka, and is quickly increased when the harvesting is delayed, particularly of early varieties. Germination decreased with late harvesting and is particularly distinct for early varieties (Ranka b=-1.02 and b=-0.43; Panonka b=-0.33 and b=-0.40) and for unfavourable weather conditions (in 1994, b=-1.02 to b=-0.33; in 1995 b=-0.43 to b=-0.01).

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