COMPARISON OF THE NODAL DISTRIBUTION OF YIELD COMPONENTS OF INDETERMINATE SOYBEANS AT DIFFERENT PLANTING DATES

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ABSTRACT

Yield components on the nodes of soybean cultivars have different effects on yield. So, the nodal distribution of yield components is important. No report has yet been published on the effect of planting date on this vertical distribution in Iran. In field experiment conducted in 1983, nine indeterminate soybean cultivars were planted at four planting dates, with five replications. It was found that pod number, seed number, pod weight and 100-seed weight are distributed differently along the nodes and that most of these factors are located on the middle nodes. In medium maturing cultivars the above yield components are located mostly on the upper 2/3 of the plant canopy and in early maturing cultivars on the lower 1/3 of the canopy. Yield component expression of the cultivars at different planting dates varied. In general, early maturing cultivars produced maximum pod number, seed number and seed weight at the 27 May planting date, medium maturing Woodworth at the 24 April planting date and medium maturing Clark 63 at the 27 May planting date. Woodworth had the highest 100-seed weight at the 26 June planting date and Corsoy cultivar at the 27 May planting date. Woodworth and Williams (medium maturing) and Bonus and Steel (early maturing) produced the largest seeds. Woodworth was in all respects the highest among the cultivars.

1- Assistant Professors and former Graduate Student, respectively.
مفهوم توزیع عمودی اجزا عملکرد ارقام سویا در تاریخ‌های مختلف کشور

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چکیده

اجزای عملکرد در گروه‌های مختلف ارقام سویا به میزان معناوی در افزایش عملکرد تأثیر دارند. از این رو بررسی وضعیت توزیع عمودی اجزاء عملکرد ارقام سویا از اهمیت و برخوردار برخوردار است. به‌خصوص اینکه در مورد اثرات تاریخ‌های مختلف کاستن بر ریز توزیع عمودی اجزاء عملکرد در ایران هنوز هیچ‌گزارسی منتشر نشده است.

در آزمایشاتی که در سال‌های 1362 و 1363 انجام گرفت و دمپی‌های گل گیاهانی و سویا طبق مغز و نسبت میانگین توزیع شده‌اند، بین‌شیبینی معیارهای عامل از فضه‌های وسط کوبی قرار دارد. روش کلی ارقام متوسط سر حداکثر معیارهای فضه را در دو نرمپای ملی کوبی و ارقام‌زودرس در نیمی بالی کوبی دارا می‌باشد.

اجزای عملکرد ارقام سویا در تاریخ‌های مختلف معناوی می‌باشند. برای تحلیل جداول تعداد غلاف، تعداد و زون داده در ارقام زودرس کاستن 3 گردیده و در میانه متوسط رس «کلاژن» کاستن 4 گردیده تولید شده، از نظر وزن صدایی، ارقام و یویدورس در کاستن 5 گردیده و گوشی در کاستن 6 گردیده بالاترین مقدار را داشته.

ارقام و وودورس و «ویلایه» (مونوکسی، ویلایه) و «ویلایه» (زودرس) در مرتبه دانه‌ها را تولید کرده و در گردیده و وودورس از لحاظ تنها صفات مورد بررسی نسبت به سایر ارقام بردن بود.

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INTRODUCTION

Nodal distribution patterns of grain yield components are useful in modeling soybean \( (Glycine\ max\ (L.)\ Merrill) \) growth, as factors responsible for yield differences, and in prediction of yield. Little research data are available on nodal distribution and effects of planting date on yield components in soybean.

Ramseur et al. (9) determined the influence of irrigation and intra-row spacing on the distribution of yield and yield components. They found that an increase in intra-row spacing increased the contribution of the lowest nodes to yield whereas irrigation decreased the relative contribution of the lowest nodal division.

Several studies with indeterminate soybeans have shown that most of the grain yield is located in the middle of the canopy (1,4,5,6). Weibold et al. (10) examined the yield distribution for 11 determinate cultivars grown in 0.97 m rows at 50.0 mm spacing. They found that at harvest, most pods were in the top one-third of the nodes of the canopy.

Hansen and Shibles (6) studied fruiting activities of "Hark" and "Hawkeye". They found that pod percent age at harvest time represented 37% of flowers produced in both cultivars. Great loss of reproductive structures occurred on branches and on lower main stem nodes. Flowering, podding and seed production were greatest in the lower middle portions of the plant nodes 6 to 15 on plants with 22 to 24 nodes per main stem.

Carlson et al. (3) conducted an experiment which included two soil moisture treatments and seven cultivars with differing maturity. The response of these soybeans varied considerably in their expression of seed yield and stress for individual components of yield, i.e., 100-seed weight, seed/pod, pods/node and node/plant varied over all cultivars.
The distribution of pods and seeds within a soybean canopy is influenced by genotype, plant spacing, irrigation and other environmental factors. The purpose of this experiment was to determine the influence of planting dates on the distribution of yield components in nine indeterminate soybean cultivars.

MATERIALS AND METHODS

This experiment was conducted at the experimental farm of the College of Agriculture, Isfahan University of Technology, in 1983 and 1984. The soil was a camborthid silty clay with a bulk density of 1.4 g cm\(^{-3}\), a pH of 7.5, a field capacity of 22% and a permanent wilting point of 10% by weight. Average growing season (May–October) air temperature and precipitation in this area are 22.7°C and 164 mm, respectively.

The experiment was a complete randomized split plot design with planting dates (24 April, 27 May, 20 June and 11 July)\(^1\) main plots and soybean cultivars (medium maturing cultivars\(^2\) of Williams, Clark 63, A.R.F. Blackhawk) as subplots with five replicates. The seeds were hand planted on both sides of 0.9 m apart furrows with a density of 270000 plants per hectare. Each plot was 50 (5x10) square meters. Irrigation was done once a week. Before planting the seeds, 200 kg ha\(^{-1}\) of ammonium phosphate were incorporated into the soil.

Nodal distributions were determined by harvesting 10 randomly selected plants from each plot when more than 90% of the pods turned brown. Number of nodes/plant, pods/node, seeds/pod, branches and weight of seeds were then determined.

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1. These dates are 4th of Ordibehesht, 6th of Kordad and 5th and 20th of Tir, respectively using the Persian calendar.
2. This grouping of cultivars is valid only in the Isfahan area with about 32° latitude.
RESULTS AND DISCUSSION

a) Planting Date

Table 1 shows branch number and yield components means at three planting dates. It is seen that the effect of planting date on the number of branches is not significant, but number of nodes, number of pods, number of seeds, seed weight, and 100-seed weight were affected. Yield components for the 11 July planting date were not entered into the analysis because the early cold weather in autumn did not allow maturation of these cultivars.

Table 1 shows that the 27 May planting date produced more pods and seeds and a higher seed weight than the other planting dates. The late planting (26 June) causes the plants to flower very soon and to be short in stature. This reduces grain yields. Also, the 24 April early planting causes seed filling period to be simultaneous with the hot days of summer, and hence, the seed yield is reduced. In addition, the 27 May planting had adequate time from emergence to flowering to express stature and nodes. This also caused the seed filling period to coincide with cool days of late summer.

Table 2 shows results of branch number and yield components averaged over planting dates for the nine soybean cultivars. Generally, pod number, seed number and seed weight for Woodworth were highest and for Steel was the lowest. The reason for the low number of pods and seeds, and less seed weight in Steel is that it flowers early, thus, it mature sooner than Woodworth.

As a whole, yield components of the medium maturing cultivars (Woodworth, Clark 63, Williams and S.R.F. 450) are greater than the other early maturing cultivars.
Table 1. Means of branch number and yield components of different soybean cultivars at different planting dates
(each value is the average of nine cultivars).

<table>
<thead>
<tr>
<th>Planting date</th>
<th>Node</th>
<th>Branch</th>
<th>Pod No.</th>
<th>Seed No.</th>
<th>Seed wt.(g)</th>
<th>100-seed wt.(g)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>No.</td>
<td>whole</td>
<td>stem</td>
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<td>stem</td>
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<td>24 April</td>
<td>19 a³</td>
<td>26 a</td>
<td>37.4 b</td>
<td>29.3 b</td>
<td>82.4 b</td>
<td>64.9 b</td>
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<tr>
<td>27 May</td>
<td>20 a</td>
<td>25 a</td>
<td>44.8 a</td>
<td>34.0 a</td>
<td>101.2 a</td>
<td>75.7 a</td>
</tr>
<tr>
<td>26 June</td>
<td>17 b</td>
<td>26 a</td>
<td>34.4 c</td>
<td>25.1 c</td>
<td>80.2 b</td>
<td>58.4 c</td>
</tr>
</tbody>
</table>

³ Planting date of 11 July is not entered in the analysis because the plants did not mature.

§ Means within each column followed by the same letter are not significantly different at 1% probability level by Duncan multiple range test.
<table>
<thead>
<tr>
<th>Name</th>
<th>Woodworth</th>
<th>Williams</th>
<th>Smith</th>
<th>Seed</th>
<th>S.G.</th>
<th>Fry</th>
<th>Haynes</th>
<th>Cobey</th>
<th>Clark</th>
<th>Brown</th>
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<td>33</td>
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<td>22</td>
<td>91</td>
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Table 2: Places of batch number and yield comparisons of nine cultivars (each analyzed 24 samples of three plants).
b) Nodal Distribution of Yield Components

With respect to seed size, Woodworth and Clark 63 (medium maturing group) and Bonus and Corsoy (early maturing group) had the largest seeds. Therefore, the following figures are shown only for these four cultivars.

In each cultivar, yield components are distributed differently on the nodes as also shown by others (1,3). Generally, it was found here that the yield components of medium maturing cultivars are mostly located on the upper 2/3 of the canopy with the early maturing cultivars yield components on the lower 1/3 of the canopy. This difference was probably due to solar radiation interception and leaf area distribution within the canopy.

Fig. 1 shows the nodal distribution of pod number for four soybean cultivars and four planting dates. At the 24 April planting date, Woodworth and Clark 63 had the largest pod number, especially on the middle nodes. The 27 May planting date Clark 63 produced more pods on the middle and upper nodes than for other cultivars. But, on lower nodes, Corsoy had more pods. This may be related to deeper light penetration into the canopy. At the 26 June planting date, Woodworth had more pods than the other cultivars only from the 10th node to the upper nodes. For the 11 July planting date, Woodworth and Clark 63 were not harvested, because they never matured, and the difference between Bonus and Corsoy was not significant. As a whole, the 27 May planting date produced more pods.

Fig. 2 shows the nodal distribution for seed number at different planting dates as shown in Fig. 3. At the 24 April planting date, Bonus had larger seeds than the rest of the cultivars except on the upper nodes. At the 27 May planting date, Bonus and Woodworth had larger seeds. At the 26 June planting date, Woodworth and Bonus had larger seeds on almost all nodes. Only Bonus and Corsoy produced harvestable seeds for the 11 July planting date with seeds larger than Corsoy. In general, the 11 July planting date produced smaller seeds because there was not enough time for seed fill.

Fig. 4 shows the nodal distribution of seed weight for different
Fig. 1. Pod number of soybean cultivars at planting dates of:

a) 24 April   b) 26 June   c) 11 July.
Fig. 2. Seed number of soybean cultivars at planting dates of:
   a) 24 April    b) 24 May    c) June    d) 11 July.
Fig. 3. 100-Seed weight of soybean cultivars at planting dates of:
(a) 24 April  b) 27 May  c) 26 June  d) 11 July.
Fig. 4. Seed weight of soybean cultivars at planting dates of:

a) 24 April   b) 27 May   c) 25 June   d) 11 July.
planting dates. The behavior is very similar to Fig. 1. The correlation coefficients (r) between branch number, seed number and 100-seed weight and grain yield were 0.53, 0.50 and 0.59, respectively.

**LITERATURE CITED**