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Effect of Spraying S-3307 on Yield, Dry Matter Accumulation and Distribution of Relay-Planting Soybean

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Abstract: Relay-planting soybean pattern is dominant in Southern China. However, the soybean grow flourishing easily below corn, so its yield is lower. S-3307 is a new kind of plant growth retardants, which is used in controlling flourishing growth and improving crop yield such as wheat, rice and so on. The purpose of this experiment was to explore the effect of spraying different concentrations of S-3307 at branching and first bloom stage on soybean yield, dry matter accumulation and distribution. The results showed as follows. Spraying S-3307 at branching stage could significantly influent yield and the concentration of 30, 60, 90 mg kg^{-1} was significantly higher than the contrast by 21.26, 7.64 and 5.32% separately and the effect of spraying S-3307 at first bloom was not significant. Spraying S-3307 at branching stage could significantly influent dry matter accumulation and the concentration of 30 mg kg^{-1} was higher than the contrast by 16.43% at maturing stage. Spraying S-3307 at branching stage could significantly increase the ratio of dry leaf weight and dry pod weight, while the ratio of dry stem weight was lower than the contrast at maturing stage. These indicated that spraying the lower concentration of S-3307 was propitious to dry matter accumulation, transferring to the pod and increasing the yield.

Key words: Relay-planting soybean, S-3307, yield, dry matter

INTRODUCTION

The import of soybean is increased year by year in some countries. If we want to relax the contradiction between supply and need, we must improve the soybean yield and extend the growth area. The soybean main producing region should not be expanded because of continuous cropping in the Northeastern China and the center of expanding area should be turned to the southern area (Wang and Yang, 2005). The multiple crop index of the cultivation ground is higher in Southern China, so relay-planting and intercropping soybean pattern is dominant (Wang, 1982). In the resent years, relay-planting soybean area has been expanded rapidly in Southern China (Yan *et al*., 2007). In this pattern soybean grow under the shade environment at a long time, so they grow flourishing easily, produce less pod and lower yield. S-3307 is a plant growth retardants with high-efficient and low-toxicity (Pan, 1996), which can improve the structure of crop colony (Zhang *et al*., 2002) and have the effect of controlling nutrition growth, improving reproductive growth and crop yield (Li *et al*., 1998; Zhang *et al*., 2002; Chen *et al*., 2000; Yang *et al*., 2003; Li and Yang, 2003; Yang, 2002). Many scholars have studied the effect of S-3307 on net cropping soybean (Li *et al*., 1998; Zhang *et al*., 2002; Chen *et al*., 2000), but the effect on replay-planting soybean has been reported fewer. This text aimed at the problems of replay-cropping soybean which grow flourishing easily and produce less yield and studied the effect of spraying different concentrations of S-3307 at branching and first bloom stage on soybean yield, dry matter accumulation and distribution. The purpose of this study is to screen out the spraying S-3307 concentrations and stage which is suitable for the replay-cropping higher yield.

MATERIALS AND METHODS

Soybean breed Gongxuan No.1 (late-maturing, 120-140 days); 5% S-3307 medicament (provided by Jiangsu Jianhu Pesticide Factory); Soil fertility condition is net Nitrogen (N) 3.24 g kg^{-1}, net Phosphor (P) 3.75 g kg^{-1}, net Kalium (K) 5.775 g kg^{-1}, quick result K 98.75 mg kg^{-1}, organic matter 17.33 g kg^{-1}, the PH of soil 7.

Design of experiment: The experiment was done on teaching farm of Sichuan Agriculture University, from May to October 2007. Used two factors randomized block design. A is spraying stage, A1: branching stage (6.27); A2: first bloom stage (8.2); B is spraying concentration

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(mg kg^{-1}), B0: 0; B1: 30; B2: 60; B3: 90; B4: 120; B5: 150. The experiment has 3 repetitions. The experiment bandwidth was 2 m, with wheat bandwidth 1.17 m and maize bandwidth 0.83m and the block area is 5×2 m. Soybean was planted in wheat bandwidth after wheat harvesting, sowing in 3 rows in every cincture with 30 cm hole spacing. The density is 10^5plant hm^{-2} and the base fertilizer is net N 16.2 kg hm^{-2}, P_2O_5 7.2 kg hm^{-2}, K_2O 7.2 kg hm^{-2} and top- dressing net N 16.2 kg hm^{-2} at the first bloom stage. The density of maize is $4.55*10^4$ plant hm^{-2} and the base fertilizer is net N 90 kg hm^{-2}, P_2O_5 40.5 kg hm^{-2}, K_2O 40.5 kg hm^{-2} and top- dressing net N 90 kg hm^{-2} at the bell-mouthed stage. The other farm management was according to the high yield planting technology regulations of soybean and maize.

Dry matter accumulation: Begin with the branching stage, we sampled 9 plants every 15 days with random sampling in every block, which was divided into the stem, leaf and pod. Then investigated its dry matter and calculated its average, which sum was equal to one plant dry matter.

Dry matter distribution:

$$\text{The ratio of every organs dry matter (\%)} = \frac{\text{Organ dry matter}}{\text{Aboveground biomass}} \times 100$$

The theoretical yield and yield component: In every block we sampled representational 10 plants at maturing stage, tested pod number, seed number per pod and seed weight. Then calculated per plant theoretical yield and amounted to hector yield.

Actual yield: In every block we sampled $1m^2$ investigated its actual yield.

Statistical analysis: The experiments were repeated at least 3 times with 3 replicates for each. All the data in this study were expressed as means±SD. The data were analysed using one-way analysis of variance and Duncan's multiple range test at the 5% level of significance from the DPS 6.55 package for windows.

RESULTS

Effect of spraying S-3307 on dry matter accumulation: May know by Fig. 1, the dry matter of soybean presented "S" curve, the rise speed was slower from A1 to 45 days after A1 (R1) and increased sharply from 45-90 days after A1, then the speed became slower entering steady stage.

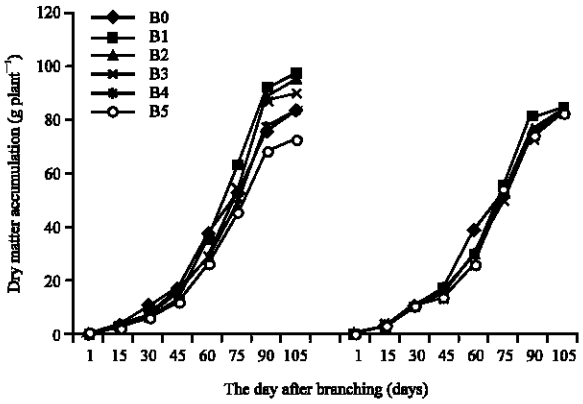

Fig. 1: The effect of spraying uniconazole on dry matter accumlation of soyabean

The trend of dry matter accumulation not be changed but the suitable spraying stage and concentration was propitious to dry matter accumulation after spraying S-3307. The difference of dry matter accumulation between spraying at A1 and the contrast was not significant before R3 (60 days after branching), that of B1, B2, B3 surpassed the contrast after R3 and surpassed the contrast by 16.43, 14.03 and 7.81% after branching 105 days (R7). The effect of spraying at A2 on dry matter accumulation was not remarkable.

Effect of spraying S-3307 on dry matter distribution

Ratio of leaves dry weight to aboveground biomass: May know by Table 1, the ratio of leaves dry weight presented downtrend. The descending speed was slower from A1 to 75 days after A1 (R4) and that was sharply from R4 to R7, which was resulted from assimilation matter in leaves transferring to pods. The changed trend of spraying at A1 had a little change, that showed increased firstly, then descended 15 days after A1 and the leaves ratio was higher significantly than the contrast since 15 days after A1, as the concentration increased, the effect increased. The difference of leaves ratio between the contrast and spraying at A2 was not remarkable. As far as the reduced percentage since R3 (60 days after A1), B5 and B1 was higher significantly than the contrast when spraying at A1, but that was not remarkable difference between spraying at A2 and the contrast. These showed that spraying at A1 was propitious to leaves dry matter accumulation and suitable concentration was propitious to assimilation in the leaves transfer to the pod.

Ratio of stems dry weight to aboveground biomass: May know by Table 2 that the ratio of stem dry matter weight presented increased firstly and reached supreme value at

Table 1: The effect of spraying S-3307 on the ratio of dry leaf weight (%)

	The day after branching (d)								
Treatment	1	15	30	45	60	75	90	105	Difference of percentage between 60 and 105 days after branching (%)
A1B0	57.38a	53.78d	48.15c	45.16c	44.45f	40.10b	29.19b	16.36e	28.09def
A1B1	55.66a	59.94c	51.44bc	47.61bc	46.69d	41.99a	31.78a	17.34d	29.35bc
A1B2	55.25a	62.58b	50.26c	47.63bc	47.02d	42.04a	32.86a	18.74c	28.28cdef
A1B3	54.73a	62.98b	54.86b	47.65bc	47.76c	42.36a	33.00a	20.31b	27.45ef
A1B4	55.90a	65.73a	55.02b	50.62b	48.85b	42.86a	33.17a	21.71a	27.14f
A1B5	55.58a	64.87ab	59.08a	54.39a	49.81a	43.50a	32.07a	19.15c	30.66a
A2B0	57.38a	53.40d	48.15c	45.16c	44.45f	40.10b	29.19b	16.36e	28.09def
A2B1	54.35a	54.68d	48.15c	46.82c	46.91d	40.04b	31.71a	17.15de	29.76ab
A2B2	56.95a	52.98d	48.15c	47.46bc	45.64e	39.92b	31.82a	17.23de	28.41cde
A2B3	54.82a	54.17d	48.15c	46.31c	46.70d	40.10b	31.82a	17.80de	28.90bcd
A2B4	54.05a	53.68d	48.15c	47.33bc	45.81fe	40.02b	32.16a	17.04de	28.77bcd
A2B5	53.49a	52.67d	48.15c	47.32bc	45.40e	40.06b	32.25a	16.91de	28.49cde

Values within column followed by a different letter are significantly different at 5% level of probability. The same below

Table 2: The effect of spraying S-3307 on the ratio of dry stem weight (%)

	The day after branching (d)								
Treatment	1	15	30	45	60	75	90	105	Difference of percentage between 60 and 105 days after branching (%)
A1B0	42.62a	46.22a	51.85a	54.84a	55.05a	51.57abc	45.32a	39.38a	15.68bc
A1B1	44.34a	40.06a	48.56ab	52.39ab	52.96cd	50.71abc	45.32a	36.06b	16.91bc
A1B2	44.75a	37.42bc	49.74a	52.37ab	52.70de	50.37abc	41.87cd	36.56b	16.14bc
A1B3	45.27a	37.02bc	45.14b	52.35ab	51.93e	49.91bc	41.34d	36.14b	15.79bc
A1B4	44.10a	34.27d	44.98b	49.38b	50.96f	48.71c	42.35bcd	33.68c	17.28b
A1B5	44.42a	35.13cd	40.92c	45.61c	50.00g	50.13abc	43.55abc	29.58d	20.42a
A2B0	42.62a	46.60a	51.85a	54.84a	55.06a	51.57abc	45.32a	39.38a	15.68bc
A2B1	45.65a	45.32a	51.85a	53.18a	52.62de	53.05abc	45.44a	39.11a	13.51de
A2B2	43.05a	47.02a	51.85a	52.54ab	53.89bc	54.34ab	44.11ab	38.93a	14.96cd
A2B3	45.18a	45.83a	51.85a	53.69a	52.99cd	54.15ab	43.65abc	40.26a	12.74e
A2B4	45.95a	46.32a	51.85a	52.67ab	53.83bc	54.63a	43.35abcd	40.53a	13.30de
A2B5	46.51a	47.33a	51.85a	52.68ab	54.21ab	53.72ab	43.22abcd	38.78a	15.43bc

Table 3: The effect of spraying S-3307 on the ratio of dry pod weight (%)

	The day after branching (d)					
Treatment	60	75	90	105	120	Difference of percentage between 60 and 105 days after branching (%)
A1B0	0.50a	8.33a	25.49a	44.26c	59.27g	58.77g
A1B1	0.34cd	7.30ab	22.90a	46.60b	61.80de	61.46de
A1B2	0.28f	7.59ab	25.27a	44.71c	62.31d	62.04d
A1B3	0.31de	7.73ab	25.65a	43.54cd	66.70b	66.39b
A1B4	0.19g	8.44a	24.48a	44.61c	65.30c	65.11c
A1B5	0.19g	6.37bc	24.38a	51.27a	69.33a	69.13a
A2B0	0.50a	8.33a	25.49a	44.26c	59.27g	58.77g
A2B1	0.47a	6.91abc	22.84a	43.74cd	59.25g	58.78g
A2B2	0.47a	5.74cd	24.07a	43.85cd	57.86h	57.38h
A2B3	0.31ef	5.75cd	24.54a	41.95e	58.21h	57.90h
A2B4	0.36bc	5.34d	24.49a	42.44de	60.75f	60.39f
A2B5	0.39b	6.22bcd	24.53a	44.31c	61.35ef	60.96ef

Note: The plant dry weight of 120 days after branching was equal to dry stem weight plussing dry pod weight

60 days after the branching (R3), then descended. That of spraying at A1 presented descended firstly and increased since 15 days after A1 and reached supreme value 60 days after the A1, then descended. The ratio of stem was lower than the contrast significantly since 15 days after A1, as the concentration increased, the effect increased. The difference of stems dry weight ratio between the contrast and spraying at A2 was not remarkable. As far as the reduced percentage since 60 days after A1, the stems ratio is higher than the contrast by spraying at A1, but that of spraying at A2 was lower than the contrast. These indicated that spraying at A1 was propitious to stems accumulation transfer to the pod.

Ratio of pods dry weight to aboveground biomass: May know by Table 3, the ratio of pod dry matter weight presented increased sharply since R3. The rising speed of spraying at A1 is faster than that of the contrast since 90 days after A1 (R4) and the pod ratio is higher than that of the contrast significantly at maturing stage, as the concentration increased, the effect increased. The pod ratio of B4 and B5 was higher than the contrast but that of B1, B2 and B3 was lower by spraying at A2. As far as the increased percentage of pods since R3, the ratio was higher significantly than the contrast by spraying at A1. Which indicated that spraying S-3307 was propitious to pod dry matter accumulate at A1.

Table 4: The effect of spraying S-3307 on soybean yield

	Theoretic yield (kg hm^{-2})		Actual yield (kg hm^{-2})	
	A1	A2	A1	A2
B0	2493.329c	2493.063c	1830.033c	1830.033c
B1	3023.391a	2420.252c	2254.408a	1819.224c
B2	2683.916b	2408.766c	1994.997b	1807.56c
B3	2625.908b	2459.806c	2003.064b	1805.653c
B4	2425.735c	2454.258c	1837.267c	1805.447c
B5	2258.879d	2479.998c	1802.288c	1791.408c

Table 5: The effect of spraying S-3307 on seed number per pod and 100-seed weight

	Seed number per pod		100-seed weight (g)	
	A1	A2	A1	A2
B0	1.584cd	1.584cd	25.278b	25.278b
B1	1.498e	1.667ab	26.691a	25.085b
B2	1.634bc	1.570cd	25.091b	25.223b
B3	1.722a	1.576cd	25.590ab	25.682ab
B4	1.725a	1.552de	26.081ab	26.000ab
B5	1.711a	1.571cd	26.090ab	25.968ab

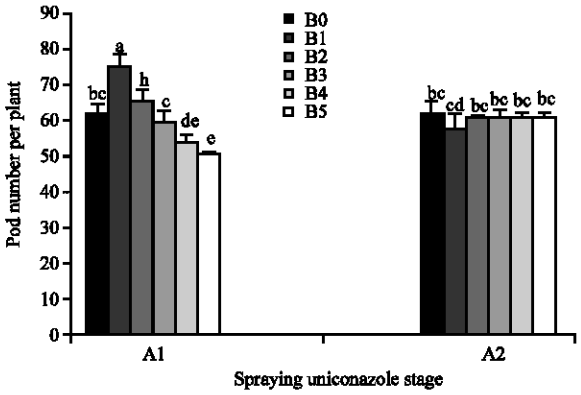

Fig. 2: The effect of spraying uniconazole on soybeanpod number

Effect of spraying S-3307 on yield

Yield: May know by Table 4 that the yield of spraying at A1 was different significantly with the contrast and that of B1, B2 and B3 was higher than the contrast significantly. That of B1 was the highest and surpassed the contrast by 21.26% and that of B4 and B5 was lower. The yield among concentrations had a little difference when spraying at A2 and the difference was not remarkable with the contrast.

Yield component: May know by Fig. 2 that the pod of spraying at A1 was different significantly with the contrast and that of B1 was increased by 21.15% than the contrast and that of B4 and B5 was lower significantly and the sequence among concentrations was B1>B2>B0>B3>B4>B5. The difference between that of spraying at A2 and the contrast was not remarkable.

May know by Table 5, the effect of spraying at A1 on seed number per pod was significant and that of B3, B4 and B5 was higher significantly than the contrast. The seed number per pod had not been remarkable difference with the contrast except B1 when spraying at A2. The effect of spraying S-3307 on 100-seed weight was not remarkable except A1B1, which was higher significantly than the contrast.

DISCUSSION

There were many reports about the effect of S-3307 on soybean growth and yield, but the results were different. The effect of spraying S-3307 at the first bloom stage on pods, seed number per pod and 100-seed weight were increased to some extent and finally resulted in increasing soybean yield significantly (Zhang *et al*., 2002; Li *et al*., 1998). Some studied indicated that the effect of spraying S-3307 at branching or first bloom stage on yield was increased but was not remarkable (Pei *et al*., 2001). Chen *et al*. (2000) studied the relation between dry matter accumulation and spraying S-3307 at the first bloom stage under net cropping, which indicated that the dry matter accumulation could be increased significantly by spraying S-3307. This study showed as follows, the yield and dry matter accumulation of soybean was increased significantly by spraying suitable concentration S-3307 at branching stage, which were not remarkable different with the contrast by spraying S-3307 at first bloom stage. These may because soybean breed in this study was Gongxuan. NO.1, whose plant type was large and planted under the shade environment. The plant was smaller at branching stage, so spraying suitable concentration S-3307 can play an important role on controlling flourishing and increasing pods, which is associated with the yield. But the plant was flourishing at first bloom stage and the rainwater was more in this season in Ya' an and the concentration in this study could not show the effect on controlling flourishing, so we should test the effect of spraying increased concentration at first bloom stage.

This study showed as follows by spraying lower concentration S-3307 at branching stage. The dry matter accumulation was higher significantly than the contrast after R3 and the ratio of pod dry matter weight was higher than the contrast at maturing stage. The ratio of stem dry matter weight was lower (Table 2), which was the same as the result of Chen *et al*. (2000), but the ratio of leaves dry matter weight was higher than the contrast (Table 1) at R7. Whether, this was related to the prolonging leaves function stage by spraying S-3307, which need further studied. This research showed as follows by spraying lower concentration S-3307 at branching stage. The ratio of dry matter distribution to leaves was higher and that to stems was lower in the whole growth period and the assimilation which was transfered to the pod stored in the

leaves was higher than that stored in the stems after R3, with 150 mg kg^{-1} was the highest, 30, 60, 90 mg kg^{-1} secondly. The yield presented reduced as the concentration increased at maturing stage, which was because dry matter accumulation by lower concentration spraying was more and transfer ratio was higher after R3. About the physiological mechanism of the relation between the dry matter accumulation and the transfer ratio, it should be studied further.

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REFERENCES

Chen, D.Q., Y.N. Li and C.L. Peng, 2000. The Efect of S-3307 on Growth Characteristic and Yield of Soybean. J. Hubei Agric. College, 20 (2): 108-110.

Li, Q.M. and W.Y. Yang, 2003. Morphological Efect of Soaking Seed with S-3307 on High Quality Seedling of Maize. J. Maize Sci., 11 (3): 66-69.

Li, Y.X. *et al*., 1998. The Crop of Soybean Is Increased by S-3307. Tian Jin Agric. Sci., 4 (2): 13-14.

Pan, R.Z., 1996. Effect of Plant Growth Retardants on Physiology. Plant Physiol. Commun., 32 (3): 161-168.

Pei, G.Y., G. Guo and Y.F. Wang *et al*., 2001. Study of Chemical Control Stage and Dosage on Summer Soybean. Crops, (5): 17-19

Wang, J.L., 1982. Soybean. Haerbin: Hei Longjiang Technology Press, pp: 63-64.

Wang, Z. and W.Y. Yang, 2005. The New Planting Pattern of Soybean in The Southern Mound District. The Researching Corpus of Crop Cultivation Physiology. Beijing: China Agric. Press, pp: 507-508.

Yan, Y.H., W.Y. Yang and X.Z. Li *et al*., 2007. Effect of Different Varieties and Sowing Dates on the Yield of Relay-cropping Soybean in the Mound District. Soybean Sci., 26 (4): 544-549.

Yang, W.Y., Q.M. Li and W.B. Ma, 2003. Effect of Soaking Seed with S-3307 on High Quality seeding of Cucumber China. Vegetables, (1): 6-8.

Yang, W.Y., 2002. The Accommodation Mechanism of S-3307 on Wheat Growth and Development, pp: 1-11.

Zhang, C.C. and Y.F. Wang *et al*., 2002. Effect of S-3307 Applying on the Soybean. Soybean Sci., 21 (2): 151-153.