การใช้สารกำจัดวัชพืชบางชนิดในข้าวโพดหวาน

Chemical Weed Control in Sweet Corn[1]

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Weeds constitute one of the major problems in growing corn in Thailand. The general practices for controlling weeds are hoeing and hand weeding, operations that are time consuming and expensive. In the lowlands of Bangkok and neighboring areas, sweetcorn is planted in raisedbeds to prevent flooding during the rainy season. This method of cultivation does not allow the usual types of mechanical weed control. Chemical weed control, on the other hand, may prove effective and economical.

The use of herbicides in controlling weeds in commercial corn plantings has become a common practice particularly in the United States. Simazine, one of the first effective selective herbicides used in corn, was developed in Switzerland. Field tests of this herbicide in the United States in 1956 indicated that season-long weed control can be obtained without crop injury (Klingman, 1961). Subsequently other preemergence herbicides such as atrazine, Randox T and diuron appeared, and the literature on these as well as other herbicides has mounted. Noll (1961) reported that simazine at 4 lbs. per acre, and atrazine at 3 lbs. per acre produced 100 percent weed control in sweet corn and gave significantly higher yields than the unweeded control. Trevette and Littlefield (1962) showed that among several herbicides tested, atrazine at 2 lbs. and Niagara 5778 [2, 4-dinitro-6 -(2-propyl) phenyl acetate] at 8 lbs. gave complete control of annual broadleaves and grasses and produced the highest corn yields. In Iowa band application of atrazine and CDAA: TCBC equaled the performance of shallow cultivation and was superior when wet weather delayed or interfered with shallow cultivation (Staniforth and Lovely 1964). Stroube and Ascheman (1961), Vega et al (1964), Wilcox (1963) and Wilkerson (1961) have demonstrated the effective control of weeds in corn with both simazine and atrazine. Other reports reflect similar results and need not be cited here.

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Despite the rapidly growing world literature on herbicide research, no report on chemical weed control of corn in Thailand is available. In the fall of 1962 a research program on chemical weed control in horticultural crops was initiated at Kasetsart University. In the research reported here, an attempt was made to establish the efficacy of several preemergence herbicides in controlling corn weeds under the conditions prevailing in Bangkhen, Bangkok.

MATERIALS AND METHODS

Five experiments were conducted during different seasons of the year on heavy clay soil in Bangkhen, Bangkok. Each experiment was arranged in a randomized complete block design with 4 replications except for the first experiment which comprised 3 replications. The experimental unit was 3×7 meters and contained 35 hills spaced 50×100cm. Before seeding duck manure at the rate of 4 kg./m^2 was worked into the soil. Herbicides were sprayed one or two days after seeding. The sprays were applied at approximately 30 psi. with a knapsack sprayer using double 85 degree tee jet nozzles. Within 10 days after germination corn seedlings were thinned to 3 plants per hill. Nitrolime (21% N) at the rate of 30 g./ hill was applied after thinning, and 10–10–10 and 5–10–10 fertilizers at the rate of 30 g./hill were applied 10 and 20 days after thinning respectively. The plants were irrigated twice daily except in the rainy season.

The variety, Hawaiian Sugar, was used in all tests. Observations on weed control were made 1 and 2 months after herbicide application. The corn was usually hervested about 2 months after sowing, and yields were statistically analyzed to determine phytotoxic effects.

The first experiment was initiated at the beginning of the rainy season on May 17, 1963, and included simazine and atrazine at 1, 2 and 4 lbs. per acre, and Dacthal at 3, 6 and 9 lbs. per acre. Harvesting of corn was completed on July 23, 1963.

The second experiment was conducted during the rainy season. Corn seed was sown on August 21, 1963 and herbicides were applied the following day. Simazine and atrazine at 1, 2, and 4 lbs. per acre and Randox T at 2, 4 and 8 qts. per acre comprised the herbicide treatments. Harvesting of corn was completed on October 26, 1963.

The third experiment was conducted during the cool and dry season. The corn was seeded on November 26, 1963 and harvested on February 2, 1964. The herbicide treatments were identical to those of the second experiments.

The fourth experiment was conducted during the hot and dry "summer". Seed was sown on April 6, 1964. Atrazine at 1, 2 and 4 lbs. per acre, Randox T at 2, 4 and 8 qts. per acre and Tordon at 0.6, 1.2, and 2. 4 fl. oz. per acre comprised the herbicide treatments. The corn was harvested on June 8, 1964.

The fifth and final experiment was initiated during the wet season. The corn was sown on July 4, 1964, and harvested on September 7, 1964. Atrazine at 1, 2 and 4 lbs. per acre, Randox T at 2, 4 and 8 qts. per acre and Tordon at 1.2, 2.4 and 4.3 fl. oz. per acre were included.

RESULTS

First Experiment

Table 1 summarizes the results of this experiment. Excellent weed control was obtained with both simazine and atrazine at 4 lbs. per acre. At the lower concentrations, atrazine appeared to be more effective than simazine. At 2 lbs. per acre atrazine gave good control until the time of harvest of corn. Atrazine showed no injury to corn, whereas simazine at 4 lbs. per acre reduced seed germination and appeared to suppress plant growth and reduce yield, although differences were not statistically significant.

Dacthal resulted in a fair weed control but caused severe injury to corn at the higher concentrations.

No significant differences in corn yield were observed between the hand-weeded controls.

Table 1. The effect of simazine, atrazine and Dacthal on weeds and sweet corn

Treatment lbs. per acre	% Germination of corn	Deg. of weed control*		Av. yield kg.
		6/16/63	7/18/63	
Simazine 1	98.3	1.7	1.0	23.1
2	97.7	2.6	1.0	21.5
4	78.3	4.0	4.0	19.2
Atrazine 1	98.3	4.0	2.0	20.8
2	94.0	4.0	3.0	20.7
4	96.0	4.0	4.0	22.0
Dacthal 3	78.7	2.0	1.0	20.0
6	78.3	2.6	1.0	14.4
9	26.7	3.0	2.0	13.3
Control–not weeded	100.00	1.0	1.0	20.8
Control–hand weeded	98.3	4.0	4.0	22.3
LSD 5%				7.16

* 4=excellent, 3=good, 2=fair, 1=poor

Second Experiment

As in the previous experiment excellent weed control was obtained with both simazine at 4 lbs. per acre (Table 2). Again at the lower concentrations atrazine was much more effective than simazine. No phytotoxic effects were noted for atrazine. With simazine at 4 lbs. per acre, however, seed germination was reduced.

Randox T gave good to excellent control at the higher concentration of 8 qts. per acre. It was not as effec-

tive at the lower concentrations.

Yield data for this experiment were invalidated due to heavy bacterial infestation on the young plants.

Table 2. The effect of simazine, and Randox T on weeds and sweet corn

Treatment	% Germination of corn	Degree of weed control*	
		9/21/63	10/21/63
Simazine 1/acre	99.0	2.2	1.0
2/acre	98.8	2.3	1.0
4/acre	84.2	4.0	4.0
Atrazine 1/acre	98.2	3.5	2.0
2/acre	99.8	4.0	3.0
4/acre	98.5	4.0	4.0
Randox T 2qts./acre	97.5	2.2	1.0
4qts./acre	97.2	2.7	2 5
8qts./acre	96.8	4.0	3.0
Control–not weeded	99.0	1.0	1.0
Control–hand weeded	98.5	4.0	3.5

* 4=excellent, 3=good, 2=fair, 1=poor

Third Experiment

The results of the third experiment are shown in Table 3. Like the previous experiment simazine, atrazine and Randox T at the highest concentrations gave highly satisfactory weed control. Also atrazine at 2 lbs. per acre showed adequate control. No phytotoxicity of atrazine was evident. Simazine at 4 lbs. per acre, however, significantly reduced the yield of corn, but at 1 lb. per acre, it produced the highest yield,indicating a possible stimulatory effect.

Table 3. The effect of simazine, atrazine Randox T on weeds and sweet corn.

Treatment	Degree of weed control*		Av. yield kg.
	12/26/63	1/27/64	
Simazine 1/acre	3.5	2.1	23.8
2/acre	3 8	2.2	21.8
4/acre	4.0	3.5	19.3
Atrazine 1/acre	3.8	2.4	22 8
2/acre	4.0	3.4	23.6
4/acre	4.0	4.0	23.8
Randox T 2qts./acre	3.5	2.2	21.9
4qts./acre	3.7	2.6	23.5
8qts./acre	4.0	3.0	21.4
Control–not weeded	3.0	2.1	21.4
Control–hand weeded	4.0	3.4	23.1
LSD 5%			2.36
1%			3.17

* 4=excellent, 3=good, 2=fair, 1=poor

Fourth Experiment

Atrazine at 4 lbs. per acre completely controlled weeds from the time of planting to harvesting of corn (Table 4). Atrazine at the lower concentrations and Randox T at 8 qts. per acre gave good control, while Tordon at the highest concentration of 2.4 fl.oz. per acre gave only fair to good control. It appeared that the concentration of Tordon was not high enough to effectively control weeds.

Although slight, the reductions in yield through the highest concentrations of atrazine and Randox T were statistically significant. Atrazine at 2 lbs. per acre gave no significant reductions in yield. The differences in yield between the hand-weeded and unweeded controls were significant.

Table 4. The effect of atrazine, Randox T and Tordon on weeds and sweet corn

Treatment	% Germination of corn	Degree of weed control*		Av. yield kg.
		5/6/64	6/4/64	
Atrazine 1/acre	90.8	3.5	2.5	24.6
2/acre	85.2	4.0	3.4	23.6
4/acre	87.5	4.0	4.0	22.1
Randox T 2qts./acre	91.7	1.5	1.5	24.2
4qts./acre	80.8	2.7	1.9	23.5
8qts./acre	89.4	3.2	3.2	22.4
Tordon 0.6 fl.oz./acre	85.5	1.9	1.2	22.0
1.2 fl.oz./acre	90.3	2.6	1.7	23.2
2.4 fl.oz./acre	88.3	3.2	2.5	22.9
Control–not weeded	88.6	1.6	0.0	22.3
Control–hand weeded	87.8	1.6	4.0	24.6
LSD 5%	N.S.			1.51
1%				20.2

* 4=excellent, 3=good, 2=fair, 1=poor, 0=very poor

Fifth Experiment

Atrazine at 4 lbs. per acre once again completely controlled weeds from the time of planting to harvesting of corn. The lower concentrations of 1 and 2 lbs. per acre also were highly effective.

Tordon at 4.8 fl.oz. per acre gave complete control of weeds, and at 2.4 fl.oz. per acre gave good to excellent control. Randox T was effective at the highest concentration of 8 qts. per acre, but not as effective at the lower concentrations.

The reduction in yield with atrazine at the highest concentration was not statistically significant, but approached the 5% level of significance. On the other hand, Tordon at all concentrations significantly reduced corn yields. No phytotoxic effects of Randox T were observed in this test.

Table 5. The effect of atrazine, Randox T and Tordon on weeds and sweet corn

Treatment	Defree of weed control*		Av. yield kg.
	8/9/64	9/3/64	
Atrazine 1/acre	3.9	3.0	26.2
2/acre	4.0	3.6	25.4
4/acre	4.0	4.0	24.7
Randox T 2qts/acre	1.9	1.2	25.9
4qts./acre	2.6	2.2	27.1
8qts./acre	3.8	3.5	27.0
Tordon 1.2 fl.oz./acre	2.8	2.4	24.2
2.4 fl.oz./acre	3.5	3.3	24.2
4.8 fl.oz./acre	4.0	4.0	20.7
Control–not weeded	0.0	0.0	26.5
Control–hand weeded	0.0	4.0	27.2
LSD 5%			2.74
1%			3.69

* 4=excellent, 3=good, 2=fair, 1=poor, 0=very poor

DISCUSSION

Simazine and atrazine at 4 lbs. per acre, Randox T at 8 qts. per acre and Tordon at 4.8 fl.oz. per acre resulted in complete to nearly complete control of weeds from the time of planting to harvesting of sweet corn. Atrazine has been particularly outstanding in giving complete weed control consistently. Even at the lower concentrations of 1 and 2 lbs. per acre atrazine resulted in adequate weed control and was superior to simazine at those concentrations. According to Vega et al (1964) in the Philippines simazine is much more effective than atrazine during the rainy season. However, in the present series of experiments conducted during both wet and dry seasons atrazine consistently performed better than simazine. The type of soil undoubtetly greatly affects the results.

Phytotoxic effects were noted, particularly at the highest concentrations of herbicides applied, but results varied slightly among the experiments, probably due to seasonal differences. In the first experiment Dacthal showed severe injury to corn and therefore it was eliminated in the subsequent experiments. Simazine at 4 lbs. per acre caused reductions in seed germination and yield of corn. Wilkerson (1961) observed that yields were significantly reduced at 2 lbs. per acre. It might be noted that simazine at the lowest concentration of 1 lbs. per acre, although ineffective in controlling weeds, showed a tendency of increasing yields. The stimulatory effects of lower concentrations

of simazine have also been demonstrated in orchids (Murashige, et al 1963). Considering the fact that simazine affects seed germination, suppresses growth and reduces the yield of corn at 4 lbs. per acre and does not adequately control weeds at the lower concentrations, it cannot be readily recommended for corn in the Bangkok region.

No phytotoxicity of atrazine was detected in the early experiments. However, in the fourth and fifth experiments slight but statistically significant reductions in yield occurred at the highest concentration, but not at the lower concentrations. Randox T generally did not exhibit phytotoxicity although in the fourth experiment a slight reduction in the yield of corn was noted at the highest concentration. Tordon showed tendencies toward reducing yields. In the fifth experiment all three concentrations showed significant reductions in yield. Although further tests are required to definitely establish the phytotoxibity of Tordon to corn, the tests conducted do not encourage its use on corn in the Bangkok area.

From the practical standpoint, it is not necessary to keep the corn plants free of weeds for the entire period from seeding to harvesting. If the plots are free of competing weeds during the first four to five weeks from sowing, the corn plants will be large enough to provide shade and prevent the extensive growth of weeds until harvest time. Therefore instead of using 4 lbs. per acre of atrazine to obtain complete control of weeds, 2 and even 1 lb. per acre should suffice in obtaining satisfactory weed control. Furthermore, at these concentrations phytotoxicity may not be encountered. Similarly Randox T at 4 qts. per acre instead of 8 qts. per acre might be recommended.

In most of the experiments conducted, no significant differences in yield were observed between the unweeded and hand-weeded or chemically controlled plots. This can probably be attributed to the fact that generally neither water nor fertility was limiting, and the plot variability did not allow the statistical detection of small differences. When water and fertility stresses are severe, weed control will probably result in greatly increased yields.

SUMMARY

A series of experiments was conducted at Bangkhen, Bangkok to determine the herbicidal effects of simazine, atrazine, Dacthal, Randox T and Tordon in various concentrations in corn plantings. The results can be summarized as follows:

1. Simazine and atrazine at 4 lbs. per acre, Randox T at 8 qts. per acre and Tordon at 4.8 fl.oz. per acre gave complete to nearly complete control of weeds from the time of seeding to harvesting of corn.

2. Atrazine at 1 and 2 lbs. per acre, Randox T at 4 qts. per acre and Tordon at 2.4 fl.oz. per acre gave adequate control. Dacthal at the highest

concentration of 9 lbs. per acre resulted in fair weed control.

3. Dacthal at 9 lbs. per acre caused severe injury to corn.

4. Simazine at 4 lbs. per acre affected seed germination, suppressed growth and reduced the yield of corn. Tordon also displayed phytotoxic effects.

5 In some experiments slight reductions in yield were observed for both atrazine and Randox T at the highest concentrations used.

6. In most of the experiments no significant differences in yields were observed for the non-controlled plots. This was probably due to the fact that soil moisture and fertility were not limiting factors.

7. Since complete weed control for the growth of corn is not necessary, satisfactory weed control can be obtained with atrazine at 1 to 2 lbs. per acre and Randox T at 4 qts. per acre.

สรุป

จากการทดลองใช้สารกำจัดวัชพืชหลายชนิด คือ simazine, atrazine, Dacthal, Randox T และ Tordon ในความเข้มข้นต่าง ๆ กันในข้าวโพดหวาน เพื่อจะหาว่าสารเคมีเหล่านี้มีคุณสมบัติในการกำจัดวัชพืชเพียงไร และจะมีผลกระทบกระเทือนต่อผลผลิตของข้าวโพดอย่างไรนั้น พอจะสรุปผลได้ดังนี้.-

1. Simazine และ atrazine อัตรา 4 ปอนด์ต่อเอเคอร์ (724 กรัมต่อไร่) Randox T 8 ควอตต่อเอเคอร์ (3.02 ลิตรต่อไร่) Tordon 4.8 ออนซ์ต่อเอเคอร์ (56.6 ซีซี. ต่อไร่) ให้ผลในการกำจัดหญ้าได้เป็นอย่างดี หรือเกือบดีทีเดียวในการปลูกข้าวโพดหวาน ตั้งแต่หยอดเมล็ดจนกระทั่งถึงวันเก็บเกี่ยว

2. ความเข้มข้นที่ต่ำลงไป คือ atrazine 1 และ 2 ปอนด์ต่อเอเคอร์ (181 และ 362 กรัมต่อไร่) Randox T 4 ควอตต่อเอเคอร์ (1.51 ลิตรต่อไร่) และ Tordon 2.4 ออนซ์ต่อเอเคอร์ (28.3 ซีซี. ต่อไร่) ก็ยังนับว่าให้ผล Dacthal ในความเข้มข้นสูงสุด คือ 9 ปอนด์ ต่อเอเคอร์ (1.629 กก. ต่อไร่) ให้ผลในการกำจัดวัชพืชยังไม่ดีนัก

3. Dacthal เข้มข้น 9 ปอนด์ ต่อเอเคอร์ แสดงผลที่เป็นอันตรายต่อข้าวโพด ทำให้การเจริญของต้นชงักและลดผลผลิตด้วย Tordon ก็แสดงผลเช่นเดียวกันนี้

5. ในบางการทดลองปรากฏว่า Atrazine และ Randox T ในความเข้มข้นสูงทำให้ผลผลิตลดลงเล็กน้อย

6. ในการทดลองส่วนมาก control ที่ทำหญ้ากับไม่ทำหญ้า ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ทั้งนี้อาจเนื่องจากว่า แปลงทดลองมีน้ำและความสมบูรณ์ของดินอย่างพอเพียง

7. เนื่องจากไม่มีความจำเป็นที่จะต้องให้แปลงปลูกข้าวโพดสะอาดจริง ๆ คือ ไม่มีหญ้าสักต้นเดียวตลอดช่วงเวลาการปลูก ดังนั้นการใช้ atrazine 1–2 ปอนด์ต่อเอเคอร์ หรือ Randox T 4 ควอตต่อเอเคอร์ จึงน่าจะให้ผลในการกำจัดวัชพืชอย่างเพียงพอแล้ว

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