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Influence of weed interference on the growth and yield of no-tillage corn (*Zea mays* L.)[1]

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Abstract : Field experiments were conducted at the experimental farm of Taiwan Agricultural Research Institute (TARI) to study the influence of weed interference periods on the growth and yield of no-tillage corn (*Zea mays* L. cv. Tainung No. 1) in the fall crop of 1991 and the spring crop of 1992. Corn was strip planted and weed interference duration ranged from 1 week after planting to full-season with weed-free check as control. It showed that more weeds were collected from corn field in Fall than in Spring. Plant height and leaf number were not significantly affected by weed interference, whereas leaf area as well as leaf weight was declined, particularly over 6 weeks of interference. The 50% tasseling and silking dates were not changed by the existence of weeds. The effective plant percentage (EPP) measured at harvest ranged from 64 to 74% and 74 to 85% in the fall crop and the spring crop, respectively. The yield of corn was reduced when duration of weed interference was more than 4 weeks, a 20% reduction of yield was resulted from 6 weeks of weed interference in 1991 and 8 weeks in 1992. It is summarized that acceptable corn yield may be maintained when weed interference was less than 6 weeks after planting under no-tillage conditions.

Key words : Weeds, Interference duration, Corn, Growth, Yield, No-tillage.

INTRODUCTION

It is a primay concern of corn producer to reduce the production costs. Corn planted in no-tillage field is one of the cultivation systems actually practicing in Taiwan for this purpose. Sheu and Chu (1991) estimated that there was an average of 15% decrease of grain yield of corn under no-tillage than that from tillage one, but the total expenses were 13% less. Weed control program and pest management that reduce weed interference on crops within the growing season are two other practices in improving the possible potential yield in no-tillage corn.

Knowledge of effect of weed interference periods on crop yield is improtant for understanding the consequences that may result from the exposure of weed infestations and for

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determining the duration that becomes economically detrimental. Sniper *et al.* (1987) reported that cotton yield was adversely affected by weeds when allowed to compete longer than 4 weeks. Wilson and Cole (1966) and Wyse *et al.* (1986) indicated that weeds must be removed by 6 to 8 weeks after emergence to prevent soybean yield reduction. How and when corn be apt to the influence of weeds in no-tillage has not been investigated and is essential for adequately applying weed practices.

The objectives of this research were to study the influence of weed interference periods on no-tillage corn growth and to determine the length of time that weed control practices could be delayed without reducing corn yield.

MATERIALS AND METHODS

The experiments were conducted at the experimental farm of Taiwan Agricultural Research Institute (24°02′ N, 120°40′ E, elevation 85 m) on a loam soil (fine-loamy, mixed, nonacid, hyperthermic, Fluvaquentic Dystrochrept) in Fall crop 1991 and Spring crop 1992. The soil contained 25.1% sand, 48.8% silt, and 26.0% clay with 1.44% organic matter and a pH of 5.3. Corn cultivar 'Tainung No. 1' was purchased from Taiwan Seed Service (Ta-nan village, Shinshieh, Taichung, Taiwan, ROC) and was strip planted at a depth of about 4 cm and with plant distance of 25 cm on 15 July 1991 and 8 January 1992, respectively. The subplots were 5.5 m by 7.0 m with 8 rows spaced 70 cm apart. The experimental plots were prepared more than six months before planting and weed populations were the result of natural infestations. Duration of weed interference ranged from 1, 2, 4, 6, 8 and 10 weeks after planting to full-season (weedy check) with weed-free check (0 week) as control. Weeds were removed by hands from the experimental plots at the desired periods and the plots were handweeding every two weeks to keep weed free since then. The weather data were obtained from the weather station at TARI.

Fertilizer (60-90-60 kg ha^{-1} ; N-P_2O-K_2O) was applied onto the soil surface at planting and additional 90 kg ha^{+} of nitrogen was applied with equivalent at 3, 6 and 9 weeks after planting. Pesticide 2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl methyl-carbamate (3% granule, 30 kg ha^{-1}) was applied on soil surface after planting and was sprayed on the canopy using 40.64% fluid at a rate of 1.2 L ha^{-1} at 5 weeks after planting.

Six plants were sampled from each replication and plant height, leaf number, leaf area and plant dry weight were measured at the 50% of silking. Plant height was measured with a ruler stick and leaf area was determined by an area meter (LI-3000, Li-Cor, Inc., Nebraska, USA). Dry weights of root, stem and leaf were measured after oven-dried at 80 °C for 72 h. The effective plant percentage (EPP) at harvest was calculated by counting the number of plants with ear (s) in each subplot relative to the planted number expressed as a percent of the planted number. Corn yields were estimated by dry weight of ears (without husk) taken from the center two rows of each eight-row subplot by hands on 18 October 1991 and 20 May 1992, respectively. A square meter of weeds were collected from the weedy check periodically and their dry weights (oven-dried at 80 °C for 72 h) were recorded.

The experiment was a randomized complete block design with three replications. Data were subjected to analysis of variance and means were compared with Fisher's Least Significant Difference (LSD) Test at the 5% level of probability. The standard errors were

also computed.

RESULTS AND DISCUSSION

Weed interference is a major limiting factor in growing corn in no-tillage field with natural infested weeds. Adequate timing to apply weed control practices before weeds starting great impct on cron growth and yield is therefore need to be determined and is an important information required for reaching the possible potential yield.

The weather conditions during corn growth in Fall 1991 and Spring 1992 were shown in Figure 1, in which the monthly values of irradiance, daily mean temperature and precipitation were recorded. Data showed that a distinct climate was presented in either crop, which not only changed the growth pattern of corn but provided various climatic environment for weed infestations. In general more weeds were collected in Fall than in Spring during the growing seasons (Table 1). Consequently, Fall crop experienced greater impact from weed interference as that reflecting in the harvested yields (Table 5). Weed density effect has been reported in other crops such as soybean and cotton (Bloomberg *et al.*, 1982 ; Buchanan and Burns, 1971 ; Harrison, 1990 ; Wilson and Cole, 1966).

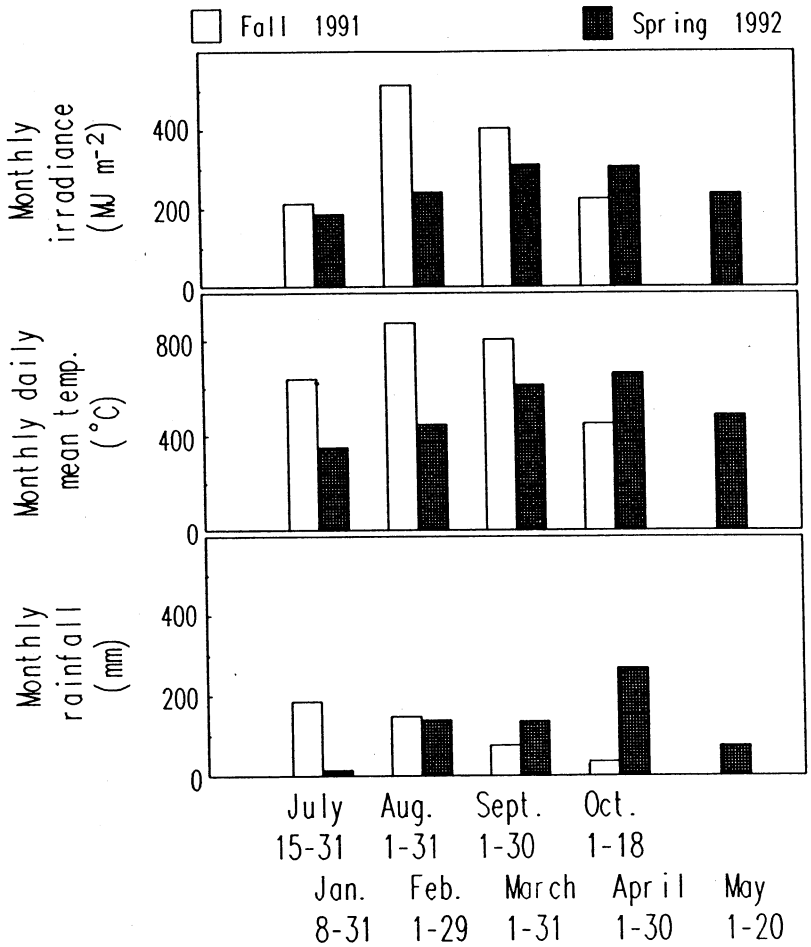

Fig. 1. The weather data during the growing seasons of fall crop of 1991 and spring crop of 1992.

Table 1. Mean and standard error of dry weight of weeds collected from no-tillage corn field during the crop seasons of 1991 and 1992.

Crop Season	Sampling date		Weed dry weight
			gm^{-2}
Fall 1991	July	15	451.25±88.54
	Aug.	8	399.81±56.98
	Sept.	10	574.70±64.28
	Oct.	18	574.70±64.28
Spring 1992	Jan.	8	331.76±74.69
	Feb.	13	338.39±40.59
	March	18	324.50±34.58
	April	20	387.42±37.79
	May	20	440.40±23.62

Growth characteristics and plant weights measured at the 50% of silking as influenced by weed interference periods were listed in Tables 2 and 3. It indicated that duration of weed interference longer than 4 weeks in Fall and 8 weeks in Spring significanly affected leaf area and plant weight, especially leaf weight. Since leaf number per plant was not affeced, leaf size was smaller, which in turn reducing the photosynthetic capacity and dry matter production. Bloomberg *et al.* (1982) pointed out that soybean yield reduction by weeds was through the decrease of total dry weight and number of pods per plant. Interference duration of 40 days or longer reduced the panicles per square meter, culms per square meter, and yield of rice (McGregor, Jr. *et al.*, 1988).

Table 2. Weed interference on some growth characteristics of no-tillage corn "Tainung No. 1" measured at the 50% of silking on 18 September 1991 and 20 April 1992.

Crop season	Duration of interference	Plant height	Leaf number	Leaf area
		cm	No. pl^{-1}	cm pl^{-1}
Fall 1991	Weed-free	223.1	11.3	5,064
	1 Week	224.2	10.3	4,824
	2 Weeks	221.5	9.7	4,548
	4 Weeks	217.9	9.3	4,449
	6 Weeks	216.1	9.3	4,241
	8 Weeks	216.0	9.7	4,412
	10 Weeks	213.2	9.3	4,388
	Weedy check	212.8	9.3	4,081
LSD (0.05)		13.5	1.7	497
Spring 1992	Weed-free	219.0	11.9	4,848
	1 Week	221.6	11.7	4,771
	2 Weeks	218.7	11.6	4,748
	4 Weeks	220.9	11.4	4,644
	6 Weeks	215.4	11.1	4,500
	8 Weeks	216.8	10.9	4,364
	10 Weeks	217.6	10.6	4,083
	Weedy check	216.8	10.5	3,970
LSD (0.05)		14.4	1.3	454

Table 3. Weed interference on dry weights of no-tillage corn "Tainung No. 1" measured at 50% of silking on 18 September 1991 and 20 April 1992.

Crop season	Duration of interference	Dry weight			sum
		leaf	stem	root	
		g pl^{-1}			
Fall 1991	Weed-free	39.30	65.24	23.62	128.15
	1 Week	37.80	64.95	23.07	126.49
	2 Weeks	35.69	64.44	22.58	122.70
	4 Weeks	34.75	64.80	22.29	121.84
	6 Weeks	33.42	62.21	20.91	116.54
	8 Weeks	34.70	62.46	20.78	119.30
	10 Weeks	32.12	61.39	21.02	116.52
	Weedy check	32.42	61.09	20.28	113.80
LSD (0.05)		3.67	7.13	3.84	7.91
Spring 1992	Weed-free	35.64	70.92	22.29	128.85
	1 Week	35.07	70.60	22.93	128.60
	2 Weeks	34.90	69.13	21.67	125.70
	4 Weeks	34.13	66.46	21.65	122.24
	6 Weeks	33.06	66.40	20.61	120.07
	8 Weeks	32.07	65.53	19.34	116.94
	10 Weeks	30.14	58.65	16.55	105.34
	Weedy check	29.32	54.02	17.00	100.34
LSD (0.05)		3.27	1.58	1.93	4.20

The development of corn, however, was not significantly altered by weeding periods. The dates of the 50% tasseling and the 50% of silking occurred on September 4 to 7 and April 17 to 20 in Fall crop and Spring crop (Table 4), respectively. Similar values of the effective plant percentage were calculated among treatments at harvest, ranged from 64 to 74% and 74 to 85% in the fall crop and the spring crop, respectively, which implied that weed interference periods did not affect no-tillage corn stands establishment.

The yield of corn was evaluated by dry weight of ears harvested from the experimental plots (Table 5). Corn yield was not reduced until duration of weed interference was more than 4 weeks after planting. For example, a 20% reduction of yield was resulted from 6 weeks of weed interference in 1991 and 8 weeks in 1992. Although the effects of duration of interference may vary with different weed species (Smith, Jr., 1968), this study demonstrated that duration of weed interference may affect corn growth and yield in a natural-infestated field in both the fall and the spring growing seasons. Weed control practices should be applied before 6 weeks after planting to prevent further corn yield reductions.

Table 4. Weed interference on the 50% tasseling and the 50% silging dates and the effective plant percentage (EPP) calculated at harvest of no-tillage corn "Tainung No.1."

Crop season	Duration of interference	50% Tasseling	50% Silking	EPP (%)
Fall 1991	Weed-free	Sept. 4	Sept. 6	73.7
	1 Week	Sept. 4	Sept. 6	68.1
	2 Weeks	Sept. 4	Sept. 6	66.3
	4 Weeks	Sept. 5	Sept. 7	65.8
	6 Weeks	Sept. 5	Sept. 7	63.8
	8 Weeks	Sept. 4	Sept. 6	63.0
	10 Weeks	Sept. 4	Sept. 6	64.3
	Weedy check	Sept. 4	Sept. 6	63.9
LSD (0.05)				10.8
Spring 1992	Weed-free	April 18	April 19	84.5
	1 Week	April 18	April 19	84.9
	2 Weeks	April 19	April 20	82.1
	4 Weeks	April 18	April 20	78.9
	6 Weeks	April 19	April 20	77.9
	8 Weeks	April 19	April 20	77.4
	10 Weeks	April 17	April 18	75.4
	Weedy check	April 17	April 19	74.2
LSD (0.05)				10.6

Table 5. Weed interference on dry weight of ears (yield) of no-tillage corn " Tainung No. 1" at harvest.

Crop season	Duration of interference	Ear dry weight (kg/ha)	index (%)
Fall 1991	Weed-free	4,260	100
	1 Week	4,040	95
	2 Weeks	3,980	93
	4 Weeks	3,580	84
	6 Weeks	3,400	80
	8 Weeks	3,440	81
	10 Weeks	3,310	78
	Weedy check	2,760	65
LSD (0.05)		650	
Spring 1992	Weed-free	5,230	100
	1 Week	5,330	102
	2 Weeks	4,750	91
	4 Weeks	4,630	89
	6 Weeks	4,570	87
	8 Weeks	4,260	81
	10 Weeks	3,910	75
	Weedy check	3,980	76
LSD (0.05)		420	

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雜草干擾時期對不整地栽培玉米生長與產量的影響[1]

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摘　要

本文研究旨在探討雜草干擾時期對不整地栽培玉米之生長與產量的影響，田間試驗分別於1991年秋作及1992春作在臺灣省農業試驗所農場進行。玉米臺農一號採條播穴植，雜草干擾時期則分從玉米播後一週至全生育，計有七種處理，而以全期無雜草干擾爲對照組。根據試驗結果，自秋作玉米田區收集之雜草量平均大於取自春作區者。雜草干擾未顯著限制玉米株高及葉片數，葉面積及植株乾重則減少，尤其當干擾時期超過 6 週以上。達到50%雄穗開花及雌穗吐絲所需日期，亦不受雜草干擾改變。收穫時，玉米有效植株百分比雖未顯著差異，但其差距高達10%；當干擾時期超過播種後4週，產量將降低，其中秋作干擾時期達 6 週及春作達 8 週時，將有20%的減產。

關鍵詞：雜草、干擾時期、不整地、玉米、生長、產量。

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