THE EFFECT OF THREE GROWTH REGULATORS ON THE EARLY GROWTH AND DEVELOPMENT OF THE SUGARCANE CULTIVAR H62-4671

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Cornelius Okinyi Olende

Thesis Committee:
Duane P. Bartholomew, Chairman
James Silva
Robert V. Osgood

We certify that we have read this thesis and that in our opinion it is satisfactory in scope and quality as a thesis for the degree of Master of Science in Agronomy and Soil Science.

THESIS COMMITTEE

Duane P. Bartholomew
Chairman

Robert V. Osgood

James A. Silva

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I. INTRODUCTION

Sugarcane breeders regularly release new cane cultivars with superior traits which improve cane quality and sugar yields or have resistance against diseases, pests and other environmental stresses. Most sugarcane producing areas of the world are thus faced with the need to rapidly propagate promising new varieties. As sugarcane is propagated through stem cuttings or setts, there is need to develop methods to increase the rate of tiller production and stalk elongation of the planting material (hereafter referred to as seedcane). In addition there is a need to minimize the acreage required for the production of seedcane. Presently six to eight-and-one-half tons of seedcane per hectare are planted in Hawaii and one hectare produces about 76.6 tons. Presently, approximately 2975 hectares are occupied in the production of seedcane in the state (USDA, 1979). Some investigation is therefore needed on possible ways to increase the number of stalks per stool in the seedcane fields. With an increased stalk population per unit of land area, there would be net savings in labor and related operational costs as well as a reduction in the number of hectares occupied in the production of seedcane.

Tiller production and stalk elongation are influenced by environmental factors such as sunlight, temperature, moisture, nutrients and growth regulators. The effect of the latter has been noticed in sugarcane ripening experiments.

Stimulation of ripening results from chemical suppression of vegetative growth by such compounds as ethephon (2-chloroethylphosphonic) acid and glyphosine [N,N-bis(phosphonomethyl) glycine] so that photosynthate accumulates in the sugarcane stalk. In this process apical dominance is weakened or destroyed and lateral buds just below the apex resume growth. It is possible that weakening apical diminance of young cane shoots may promote the development of tillers. Although most growth regulators have been shown to reduce stem growth, (R. Osgood, personal communication), some treatments with ethephon have given increased stem elongation (van Andel, 1970; Teshima, 1979).

Treating seedcane by soaking in hot water, refrigeration, or treating with growth regulating chemicals has improved germination and tillering of sugarcane. However no conclusive data on the effect of growth regulators on tillering of the Hawaiian cultivars presently in commercial use has been reported. Results from the Philippines (Rosario and Zamora, 1973) indicated that tillers produced in the field during the first eight weeks after planting survived to produce millable stalks whereas tillers produced later died off and did not contribute to cane tonnage. Promotion of tillering and stalk elongation early in the crop cycle may therefore result in increased production of seed cane.

The purpose of this research was to study the effect of ethephon, glyphosate[(N-phosphonomethyl) glycine] and mefluidide (N-(2,4-diethyl-5-[[(trifluoromethyl)-sulfonyl]-amino]phenyl]acetamide), compounds observed to have growth regulating activity, on tiller initiation and stalk elongation of the sugarcane cultivar H62-4671.

II. REVIEW OF LITERATURE

EFFECT OF ENVIRONMENT ON TILLERING AND STALK ELONGATION

The effect of various environmental factors on tillering and culm development in grasses has been investigated by a number of workers. Soon after planting, the buds of the sugarcane seedpiece resume growth, emerge from the soil and develop into shoots. These are the so called 'mother shoots' or the primary shoots. The basal part of the stems of these primaries consists of many short internodes, each of which has a lateral bud. Some of these buds give rise to secondary shoots which in turn produce tertiary shoots in a succession until the stool consists of many stalks. Shamel (1924) described a stool which developed from a stem cutting having a single bud that consisted of 144 stalks and weighed 152 kg. after stripping off the leaves.

The effect of light intensity on the tillering of 16 varieties of sugarcane was studied in Hawaii. Cane grown in full sunlight had significantly more tillers per stool than cane grown in 50% shade (Takahashi, et al., 1965). The number of tillers produced by cane growing in pots covered with muslin of various thicknesses (Verret and McLennan, 1927) or with various layers (Martin and Eckart, 1933) increased with decreasing shade. The effect of light intensity on tillering was reported by van Dillewijn (1952) to be associated with the activity of endogenous growth regulating substances. Under high light intensity, the downward stream of growth inhibiting substances diminished. Subsequently, the elongation rate of the stem slows down and the degree of bud inhibition diminishes, resulting in the production of tillers. With reduced light the downward stream of growth regulators increased resulting in an accelerated rate of stem elongation and increased bud inhibition, thus preventing the production of tillers. In an experiment with sudan grass Shen and Harrision, (1965) observed that under low light intensities tillering was delayed and at the lowest light level (3230 lux)., tillering was completely suppressed. In addition to their observation of increased tillering with increased sunlight, Martin and Eckart (1933) also noted that stalks grown in full sunlight were thicker but shorter, while plants grown under low light intensity had long, slender succulent stalks.

Competition for light caused by crowding has been reported by several workers (Sieglinger and Martin 1939; Wiggans and Frey, 1957) to decrease the number of stalks or head bearing culms per plant in sorghum and oats. Several primary stalks per meter are observed in standard sugarcane practice within one month of planting. However, with the development of tillers competition sets in resulting in less than the potential at harvest (Takahashi H.S.P.A., 1966 unpublished report).

Temperature also affects the growth of plants and an experiment done in Hawaii (Anon., 1959) showed growth of shoots to be positively correlated with air temperature, root temperature and daily light duration; with tiller growth being more affected by the above factors than the primary stalks. For example, at a root temperature of 16.7°C the number of days per node dropped from 12 to 10 when air temperature was increased from 13.3°C to 23.3°C. At a root temperature of 22.2°C, increasing air temperature over the same range reduced the time required per node to as low as 7 days. Van Dillewijn (1952) reported that tillering increased with increased temperature up to a maximum at about 30°C. Subsurface irrigation of sugarcane with warm water (above 21°C) significantly increased stalk height and the number of tillers produced during the first nine weeks of growth (Mongelard, 1971.)

Depth of planting has also been shown to influence the rate of shoot emergence and the total number of tillers produced. Shen and Harrison, (1965) reported that increased depth of planting due to ridging suppressed tillering of sugarcane in Taiwan. Lee, (1953) reported that ridging sugarcane plants to a height of 40 cm. above the seedpieces decreased the number of tillers and total number of millable stalks for an 18 month crop. A similar observation was made by van Dillewijn (1952) who reported that tillering subsequent to ridging was governed by the time and degree of soil application; light and delayed earthing up promoted tillering, whereas early and heavy soil dressings inhibited tillering. Loh and Tseng (1953) observed that 40 to 60 lateral buds were produced by a single stool under the ground which could become tillers in a favorable environment.

The supply of nutrients is yet another factor that affects tillering and stem elongation of grasses including sugarcane. Significantly more tillering occurred when sudan grass plants were given sufficient and balanced nutrients than when they were not (Shen and Harrison, 1965). Similar results have also been reported for timothy, orchardgrass, and bromegrass (Macleod, 1965); and also sugarcane (Anon., 1956). In a pot culture study of tillering, a high application of nitrogen to the sugarcane cultivar H49-3533, a very low tillering variety resulted in increased tillering. (H.S. P.A., 1965, unpublished report). Increased nitrogen not only increased the number of tillers of H57-5174, but also stimulated the growth of tillers so that in a few months they became almost indistinguishable from the primary stalks (H.S. P.A. 1965, unpublished report.) Similar results on tiller growth responses to nitrogen were presented by Jung et al., (1964) and Alberta (1965) using sudan grass. In addition, a number of workers (Cooper, 1937; Das, 1936; Das and Cornelison, 1936; and Yuen and Hance, 1939) observed that the rate of cane elongation increased with the rate of nitrogen application until the optimum supply was reached.

Limited work has been done on the specific effect of potassium and phosphorus on tillering. However (Macleod, 1965) reported that for grass species, tillers increased with increased nitrogen only when the rate of potassium was increased. Phosphorus on the other hand was shown to increase the length and diameter of internodes in sugarcane (Rege and Sannabhadti, 1943).

EFFECT OF PLANT GROWTH REGULATORS

There are limited published reports on the use of growth regulators to promote tillering and stem elongation in sugarcane. Nickell and Kortschak (1964), Maretzki and Nickell (1967), Meretzki et al. (1969) and Takahashi (1969) refer in general terms to the fact that specific chemicals such as arginine and ethephon stimulate the resumption of bud growth (hereafter referred to as germination) and tillering of sugarcane in Hawaii.

Studies relating such morphological characteristics of sugarcane as tiller number, internode length and amount and structure of foliage to yield have indicated that under some conditions, early and rapid tillering is directly related to higher cane and sucrose yield (MacColl, 1976.) Early and uniform tiller production also results in a uniform stand and rapid canopy closure which is desirable for maximum energy interception (Madrid and Rosario, 1977). Early canopy closure would also help in the control of weeds. In addition, early tillering in the annual sugarcane crop was reported by Stevenson (1965) to improve the quality of the juice by reducing the proportion of succulent secondary shoots, referred to as bullshoots by sugarcane industry workers, in the harvested crop.

The effect of natural hormones on bud germination and growth of sugarcane has been quite extensively studied. For example soaking sugarcane stem cuttings in a solution containing a mixture of indole acetic acid (IAA) and naphthalene acetic acid (NAA) improved bud germination (Singh and Ali, 1974). In another experiment, soaking seed pieces in an aqueous solution of gibberellic acid also improved bud germination (Chang and Lin, 1962; Shiah and Pao, 1963). One physiological effect of soaking the setts in these natural hormones is the leaching of germination inhibitors (Singh, 1972). Synthetic auxins might have similar effect on sugarcane, but soaking treatments carried out so far have failed to increase germination or tillering (Madrid and Rosario, 1977).

During the 1950's when experimental amounts of gibberellic acid became available in the U.S.A., the chemical was shown to promote stalk elongation in cane (Coleman and Humbert, 1957; Coleman et al., 1960). Additional studies with gibberellic acid indicated that maximum response was obtained when the chemical was applied to cane three months after planting (Buren, 1971). Recent work in Hawaii [Moore, 1977; Moore, 1978; Moore and Buren, 1978; Buren et al., 1979 and Moore and Osgood (H.S.P.A., 1979, unpublished report)] have further elaborated the responses of cane to gibberellic acid, particularly stem elongation. Stimulatory effects were especially evident during the cool winter months and it was observed that two split applications of 70 g/hectare of gibberellic acid applied to young cane at 30 day intervals gave better results than a single application.

Ethephon, a compound which degrades to ethylene in the plant, has been shown by several workers (Anon., 1969; Heng and White, 1969, van Andel, 1973; and Poovaiah and Leopold, 1973), to stimulate tillering and stem elongation of a number of grass species, including Kentucky bluegrass seedlings. Madrid and Rosario, (1977) and Teshima (1979) reported that application of ethephon to sugarcane substantially increased plant height and resulted in a significant increase in cane tonnage. Earlier, Rao (1973) applied ethephon to cane and obtained increased tillering and as much as a 19% increase in yield. In recent work (Eastwood, 1979), ethephon was found to have a potential as tillering stimulant, either as a preplant dip or more practically, as a post-emergent spray. Takahashi (1971), however, noticed a reduction in stalk elongation and impeded expansion of the leaf-blades when plants were sprayed with 1,000 or 10,000 ppm ehtephon. Anon., (1978) observed that the beneficial effect of ethephon on tillering wears off about the 6th week after application, followed by a slight decline in number of new tillers produced for a period of seven weeks. From the 13th week onwards there was a rapid decline in total number of tillers and at the 28th week the tiller number in the treated plots was no greater than in the control. With a planting density of 20,000 cane setts per hectare in

Indonesia, application of ethephon to young cane about 20 to 40 cm tall resulted in such large tiller numbers that the competition for space (below and above ground), for light, moisture and nutrients was so great that many younger and weaker tillers died back (Anon., 1978). These results are in agreement to an earlier work by Rosario and Zamora (1973) which indicated that tillers produced in the field during the first eight weeks after planting survived, whereas tillers produced later died off.

Another compound observed to stimulate tillering in young cane is 2-chloroethyltrimethyl-ammonium chloride (CCC). An application of 10 kg a.i./hectare of an aqueous solution containing 500 mg per liter of CCC to the ratoon crop increased tiller production by 24.0 to 33.4 percent one to two months after treatment and resulted in a 20 to 34 percent increase in cane yield compared with untreated plots. All doses of this compound, however, did not affect the formation of sugar in the cane plant (Sheng and Twu, 1968).

Among the other compounds which show growth regulator activity at low concentration are the herbicides glyphosate [N-(phosphonomethyl) glycine], racuza (methyl-3,6 dichloro-anisate), and bualta (polyoxyethylene dimethyliminio ethylene dichloride). In studies with glyphosate, tillering of sorghum seedlings was stimulated and the fresh weight and diameter of the treated culms was increased (Baur, and Bovey, 1977). Low levels of the same chemical increased tillering in in *Agropyron repens* (quackgrass) by supressing apical dominance of the primary shoots (Coupland and Caseley, 1975). Hayamichi, *et al*. (1978) reported a similar response from standing seedcane. Madrid and Rosario, (1977) reported that application of racuza and bualta to sugarcane resulted in a substantial increase in plant height and in significant increases in cane tonnage.

Glyphosine [N,N bis (phosphonomethyl) glycine], is currently registered as a sugarcane ripener in various countries including the U.S.A. (Nickell, 1978). Nickell (1974) and Takahashi (1969), however, observed that one of the effects of glyphosine is inhibition of stem growth. The observed inhibition of growth suggests other growth regulating effects in addition to the ripening of sugarcane.

According to van Dillewijn (1952), the ability of chemicals to promote tillering in sugarcane is affected by soil properties, the aerial environment, and the nature and concentration of the chemicals used.

On the basis of the foregoing review, it is evident that the problem of tillering and stalk elongation in sugarcane requires further studies. For an example, further elaboration of the effects of growth regulators such as ethephon and glyphosate on the early development of the cane plant is needed. In addition, ways of assuring the survival of the early tillers to maturity should be investigated.

III. MATERIALS AND METHODS

This study was conducted at Kunia substation of the Hawaiian Sugar Planters' Association, Experiment Station, Island of Oahu, Hawaii from July 3, 1979 to January 23, 1980. The field is located at an elevation of 87 meters. The soil is classified as a Typic Torrox, belonging to the order Oxisols. The mean annual rainfall is 768.4 mm.

The experiment was designed to determine the effect of ethephon (2-chloroethyl phosphonic acid), glyphosate N(phosphonomethyl) glycine and mefluidide (N-[2,4-diethyl-5-[[(trifluoromethyl)-sulfonyl]amino]phenyl]acetamide) on the tillering and stalk elongation of cultivar H62-4671, a cultivar which is slow to tiller and develop a full leaf canopy. The experimental field was divided into fifty plots each 6.1 m by 6.1 m with four cane rows 1.52 m apart. The experimental design was a randomized complete block with the chemical treatments applied at the following rates as active ingredients; ethephon and melfuidide 280, 560, and 1120 g/hectare and glyphosate 67.2, 134.4 and 224 g/hectare and an untreated control. The treatments were replicated five times.

The field was drip irrigated three times a week at a rate equivalent to evaporation from a U.S. Weather Bureau class A pan. The quantity of water applied was determined by the formula: Q = A x d where 'Q' represents the amount of water in liters, 'A' the area of the field in hectares and 'd' the depth of water in cm. One hectare thus required 100,000 d liters of water. By using the daily pan evaporation readings, the required quantity of water was applied to the field. The drip system laterals (T-tape manufactured by T-Systems Corporation of San Diego, California) were laid in 10 cm deep furrows 20 to 25 cm from the seedpieces. The water lines were flushed manually to remove debris before every irrigation by opening the laterals and increasing the water pressure for a few minutes. This minimized the effect of clogging and the subsequent unequal distribution of water.

The crop was started with seedpieces cut from eight month old seedcane from an adjacent field. Three node cuttings 46 cm in length were first dipped in hot water-benlate [methyl-1-(butylcarbamoyl)-2-benzimidazolecarbamate] solution at 52°C for 20 minutes. The tank contained a mixture of 10.4 kg benlate in 4,500 liters of water. All plots were fertilized at the time of planting with a complete fertilizer (16:16:16) at the rate of 112 kg/hectare of N,P_2O_5, and K_2O respectively. The fertilizer was spread in 20 cm deep furrows mixed lightly with soil, then the seedpieces were planted with a slight over-lap and covered with 2.54 cm of soil. The planting density was 12,000 cuttings per hectare. An additional 56 kg of N per hectare was applied through the drip irrigation system at nine weeks after planting.

Five weeks after emergence, the young sugarcane plants about 30 cm tall, were sprayed with ethephon, glyphosate and

and mefluidide at the rates shown with a knapsack sprayer. The appropriate quantity of chemical was mixed with 0.87 liters of water (equivalent to 234 liters per hectare) and applied uniformly over the cane rows.

At four weeks after planting, but before treatment, and biweekly thereafter, the number of tillers in 5.5 m of the two central rows was counted. In addition, the following measurements were made on ten primary stalks selected at random from the two central rows; height measured from the base to the top visible dewlap (TVD), length of the youngest leaf having the visible dewlap and the number of green leaves. The diameter of the 13th internode of the tagged primary stalks was measured at 21 and 27 weeks after planting. The 13th internode is the internode below the 13th leaf, counting the half unfolding leaf as number one. At the time of harvest, the number of surviving tillers from 5.5 m of the two central rows, the average weight of stalks from a sampling area of 3 m by 3 m per plot (with the tops cut off at the growing point), and an estimate of the stalk sucrose content on percentage basis (pol percent cane expressed as percentage of the fresh weight of cane) were determined. Pol percent cane (PPC) was obtained by the standard pol ratio analysis method. Percent light transmission through the canopy was measured at the 19th week after planting with a tube solarimeter (Delta-T Devices type TSL) and millivoltmeter (LI-COR Instruments model LI-185). Three readings were taken in the middle of the row interspace and parallel to the row. Percent transmission was calculated from measurements of full sunlight taken at the ends of the rows. All measurements were taken between 10:30 a.m. and 1:00 p.m. A subjective grading of the plots for stand and appearance was made by a sugarcane breeder at 21 weeks after planting.

Growth in 10 plots of the treatments which were located in the eight rows at the lower end of the field was more vigorous than that in other 40 plots. In an attempt to explain the variation, crop log samples including blades and sheaths of leaves +3, +4, +5 and +6 counting the youngest emerging leaf as +1 were collected for moisture and nutrient analysis. In addition to blades and sheaths, the fifth mature internode was taken for phosphorous analysis. The samples were dried in a forced draft oven at 80°C. The tissue samples were ground to pass a 20 mesh sieve and 0.5 g of blade and 1.0 g of sheath and stalk were digested with concentrated H_2SO_4. Total plant nitrogen and phosphorus were determined colorimetrically using an autoanalyzer. Potassium and calcium were determined with a flame photometer, while magnesium, zinc, copper and iron were determined by an atomic absorption spectrophotometer. Soil nutrient analysis was accomplished by extracting 2.0 g of soil with 200 ml of 0.5 M sodium bicarbonate pH 8.5 for phosphate and 5.0 g of soil with 100 ml 1.0 N ammonium acetate pH at 7 for the other elements. The quantity of N, P, K, Ca, Mg, Zn, Cu and Fe in the extract was measured using the same procedures used for plant digests.

Due to the unexplainable difference in growth in the ten plots at the lower end of the experimental field, statistical analysis was performed using the General Linear Model Procedure [Statistical Analysis System (SAS), 1979] utilizing data collected from 40 of the 50 plots. Means were compared using Bayes Least Signficant Difference (BLSD)(Duncan, 1965). Appropriate measures were taken in calculating the BLSD for means with an unequal number of classes. An example of calculating BLSD for an unequal number of classes is given on the following page.

BLSD = S_d t ∞ $(F/F-1)^{½}$

Since means are based on varying number of replications, we must have different BLSD for comparison of number of replications, for example:

3 vs. 3	3 vs. 4
4 vs. 4	3 vs. 5
5 vs. 5	4 vs. 5

This is reflected in $S_d = \sqrt{\frac{2S_2}{n}}$ or $\sqrt{\frac{S_2}{n_1} + \frac{S_2}{n_2}}$

Therefore calculate appropriate BLSD for each combination of number of replications, varying only the S_d.

Example: 3 vs. 3

$$S_{d_3} \sqrt{\frac{2S^2}{3}} \quad ; \quad BLSD = S_{d_3}\ t\ \infty\ (F/F-1)^{½}$$

Given: n = 3

S^2 = 139.68

t∞ = 1.721

F value = 2.59

$$S_{d_3} = \sqrt{\frac{2(139.68)}{3}} = 9.649$$

Therefore BLSD = 9.649 [1.721] $[\frac{2.59}{1.59}]^{½}$

= 21.20

Example: 4 vs. 5

$$S_{d_{4,5}} = \sqrt{\frac{S^2}{4} + \frac{S^2}{5}} = (\frac{139.68}{4} + \frac{139.68}{5})^{½} = 7.93$$

Therefore BLSD = 7.928 [1.721] [1.276) = 17.41

Therefore for each mean comparison use appropriate BLSD.

IV. RESULTS

Growth of plants and their response to treatments generally was uniform in all but the 10 plots at the lower end of the field. Growth in these plots was more vigorous than in other plots. Tissue and soil analyses were performed to see if any differences in nutrient availability or uptake existed between the two areas (Appendix Tables 14,15 and 16). There was no indication of any differences in nutrient status or uptake in the two areas which could account for the differential growth response. A review of the cropping history of the field showed that in 1978, the upper end of the field was used for a phosphorus uptake experiment, while the lower end was left fallow. Pits were dug in both the upper and lower areas of the field to study root development in the two areas. It was apparent that the inhibition of root development due to compaction was the most probable cause of differences in growth in the two areas (Appendix Table 17).

The effects of various levels of ethephon, glyphosate and mefluidide on growth, tillering, stalk elongation, number of green leaves, leaf expansion, stalk diameter, fresh weight and percent pol in sugarcane were studied in the field. Only the data for the 40 plots in the upper end of the field were analysed and discussed to avoid confounding treatment effects with the differential growth responses in the two areas of the field.

VISUAL RESPONSES TO GROWTH REGULATORS

Visual observations of the effects of the growth regulators on the cane were begun one month after application of the treatments. The symptoms were seen throughout the 40 plots in the upper part of the field and were more prominent at the higher rates of treatment. Symptoms either were not apparent or were much less severe in the 10 lower plots where growth was more vigorous.

ETHEPHON: The symptoms of ethephon were not as conspicuous as those of the other chemicals. Symptoms included: reduction in length of the upper leaf laminae (Appendix, Table 22), scorching of the leaf-tip and in some cases stunted growth. These symptoms were evident only at the highest rate of application (1120 g/hectare) and during the early stages of growth.

GLYPHOSATE: At the highest rate of application of glyphosate (224 g/hectare), the spindle became necrotic while older leaves were alternately green and brown. In addition there were white streaks in the laminae parallel to the midrib. In some cases growth was stunted or the whole stalk died.

MEFLUIDIDE: The effects of mefluidide were similar to those of glyphosate. Specifically the upper leaves were twisted and torn, the spindles died back, growth was stunted, and in some cases the whole plant died.

TILLER NUMBER

The tiller numbers per foot (30.5cm) of row was obtained by dividing the total number of tillers in the two central lines per plot by 11 m (the total length of the two rows from which data were collected.) Tiller number per foot (Table 1) generally increased fairly rapidly up to about the 15th week after planting, followed by a more gradual decline up to the 25th week, probably due to the death of tillers as a result of shading. Thereafter, tiller number levelled off up to the 28th week (Figs. 1,2 and 3). Marked differences were evident among the treatments in the trend of tiller production. All ethephon treatments produced one peak of tillers about 16 weeks after planting (Fig. 1). The 1120 g/hectare treatment had significantly more tillers than the control at that time (Table 1.) Glyphosate treatments on the other hand were more inconsistent. The 224 g/hectare treatment had two peaks of tillering, the first during the 19th week of growth which was significantly greater than the control (Fig. 1) and the second one during the 16th week of growth which wasn't statistically significant. Finally mefluidide at 1120 g/hectare had two peaks of tillers during the 9th week and 14th week of growth, both statistically significant. (Fig. 2). Generally the three chemicals delayed peak tillering relative to the control.

Tiller production expressed as a percentage of the control was highest for mefluidide at 1120 g/hectare followed by ethephon at the same rate, while glyphosate at 67.2 g/hectare was the lowest (Table 2). Among the three chemicals used tiller number was increased more consistently by mefluidide and ethephon than by glyphosate.

TABLE 1.-- Effect of three growth regulators on the average number of sugarcane tillers per foot (30.5 cm) of Row for the Cultivar H62-4671.

	TREATMENT RATE	Tillers per foot of row — Weeks after Planting 9	14	19	23	28
	ETHEPHON:					
A	280 g/hectare	2.13a	2.96ab	2.53a	1.92a	1.44a
B	560 g/hectare	2.15a	2.92ab	2.36a	1.82a	1.43a
C	1120 g/hectare	2.26a	3.34a	2.70a	2.04a	1.60a
X	Control	2.15a	2.61b	2.27a	1.72a	1.29a
	GLYPHOSATE:					
D	67.2 g/hectare	2.20b	2.55a	2.03a	1.60a	1.24a
E	134.4 g/hectare	2.19b	2.67a	2.12a	1.60a	1.28a
F	224 g/hectare	2.74a	2.87a	2.29a	1.80a	1.38a
X	Control	2.15b	2.61a	2.27a	1.72a	1.29a
	MEFLUIDIDE:					
G	280 g/hectare	2.28b	2.71b	2.24a	1.68a	1.30a
H	560 g/hectare	2.55b	3.06ab	2.34a	1.75a	1.42a
I	1120 g/hectare	3.20a	3.55a	2.73a	2.18a	1.64a
X	Control	2.15b	2.61b	2.27a	1.72a	1.29a
Coefficient of variation		15.91%	14.42%	13.64%	16.17%	14.90%

Means within the same column for each growth regulator which are followed by the same letter are not significantly different at the 5% level of probability as determined by Bayes Least Significant Difference Test.

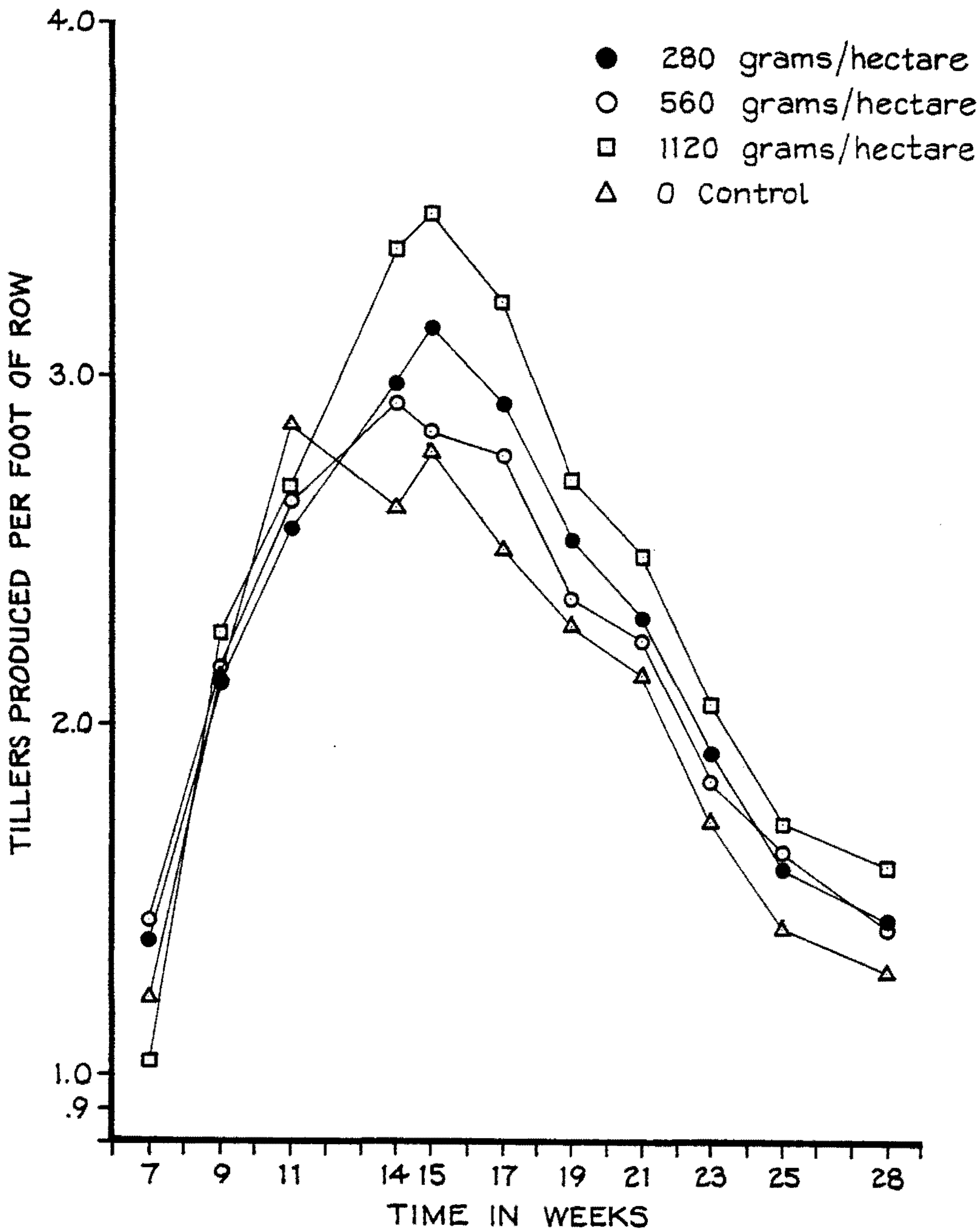

Fig. 1 Effect of Ethephon on Tillering of Sugarcane Cultivar H62-4671

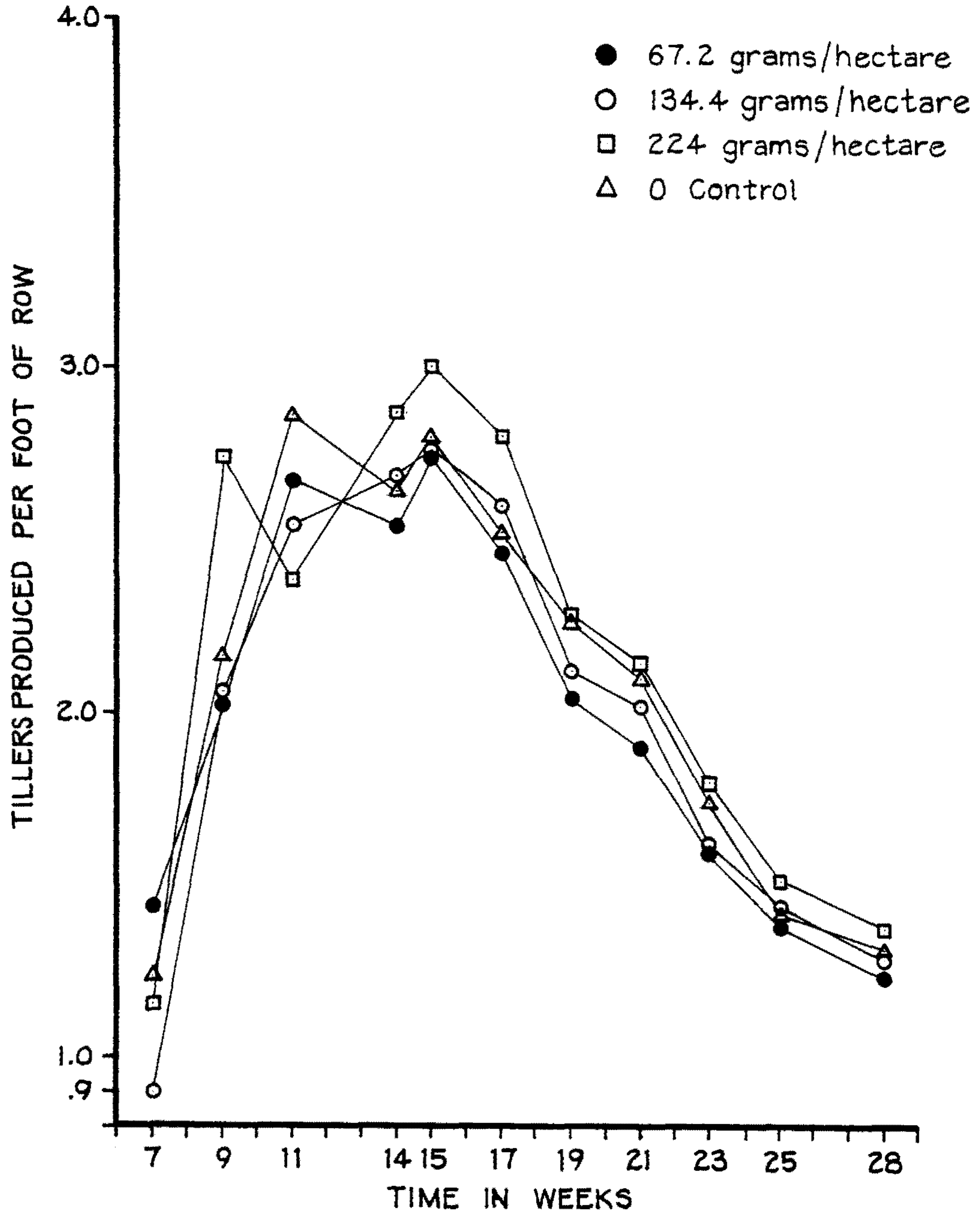

Fig. 2 Effect of Glyphosate on Tillering of Sugarcane Cultivar H62-4671

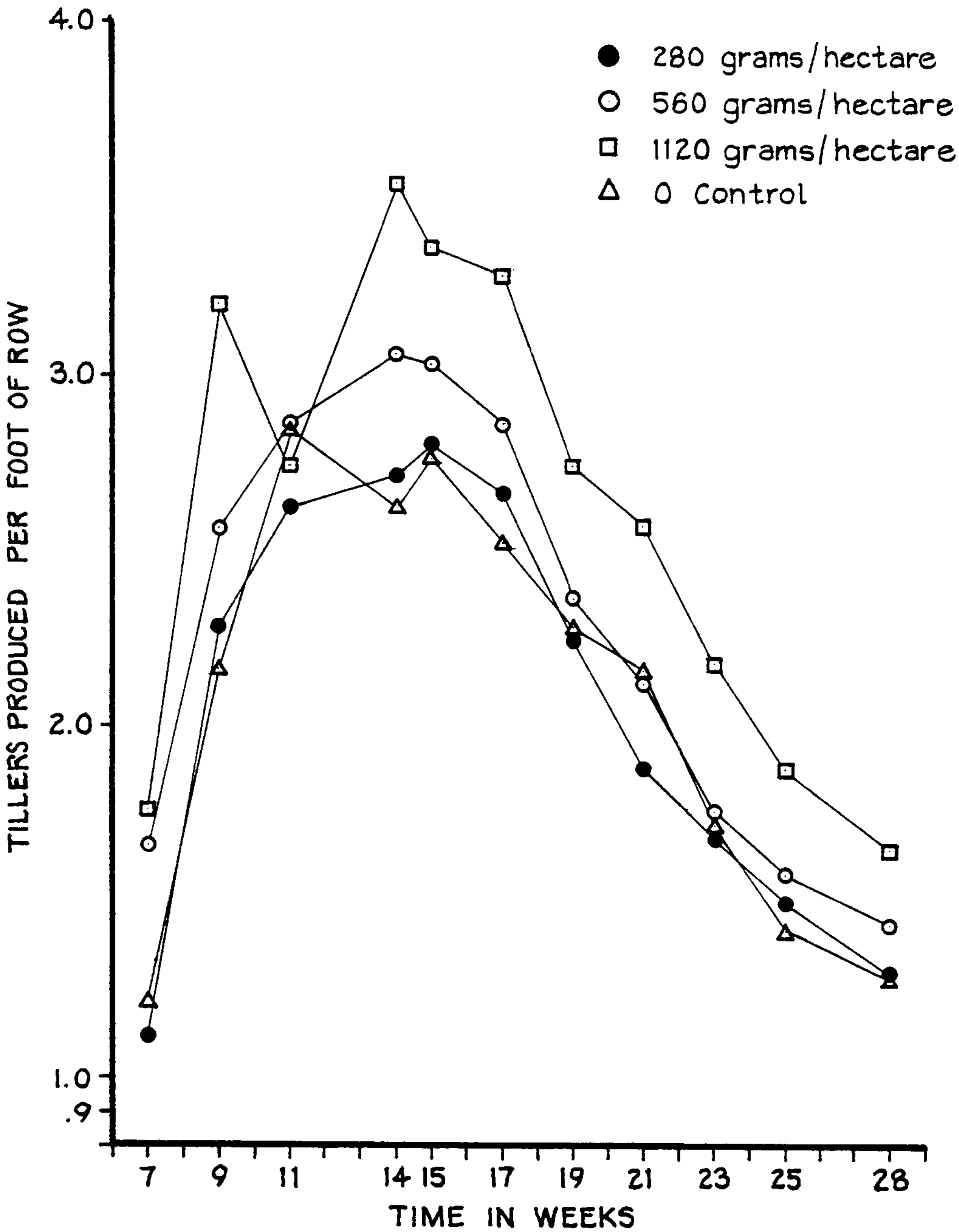

Fig. 3 Effect of Mefluidide on Tillering of Sugarcane Cultivar H62-4671

Table 2. Effect of growth regulators on the percentage increase in tiller number of sugarcane cultivar H62-4671 over the control.

	Increase in tiller number (%)*				
			Weeks after Planting		
TREATMENT RATE	9	14	19	23	28
ETHEPHON:					
280 g/hectare	-0.93	13.41	11.45	11.63	11.62
560 g/hectare	0.00	11.88	3.96	5.81	10.85
1120 g/hectare	5.12	28.35	18.94	18.60	24.03
GLYPHOSATE:					
67.2 g/hectare	2.33	-2.30	-10.57	- 6.98	- 3.88
134.4 g/hectare	1.86	2.30	- 6.61	- 6.98	- 0.78
224 g/hectare	27.44	9.96	0.88	4.65	6.98
MEFLUIDIDE:					
280 g/hectare	6.05	3.83	- 1.32	- 2.33	0.78
560 g/hectare	18.60	17.24	3.08	1.74	10.08
1120 g/hectare	48.83	36.02	20.26	26.74	27.13

*Calculated as: $\frac{\text{Number of tillers in treated plots - Control}}{\text{Control}} \times 100$

PLANT HEIGHT

Measurements of the height to the top visible dewlap (TVD) above a fixed ground point were made biweekly. Ten randomly tagged primary stalks from each plot were used. Data from 40 of the 50 plots were analyzed, due to differential growth in the lower and upper areas of the field. Because loss of the 10 plots reduced the number of replicates of some treatments but not others, the results for each growth regulator were analyzed separately. The mean for the control was used to test response to rate for each growth regulator. Growth in height of the cane treated with the lowest concentration of ethephon, glyphosate and mefluidide generally was greater than the control, although not significantly so, except for mefluidide at 19 weeks (Table 3, Figs. 4,5 and 6). The effect of higher concentrations of ethephon was small and somewhat variable. The higher concentrations of mefluidide and glyphosphate generally reduced growth in height. Plant heights were less than the control for at least 14 weeks after spraying at the intermediate treatment level. Plant height was less than the control throughout the experimental period at the highest treatments. However, examination of Figures 5 and 6 indicates that the growth rate of the cane at the high levels of treatment was retarded only for about 14 weeks, after that time the slopes of the curves for the treatments and the control were similar.

TABLE 3. -- Effect of three growth regulators on the height of sugarcane cultivar H62-4671. Values are the means of five replications.

	Average Stalk Height, cm					
	Time in weeks after planting					
TREATMENT RATE	4	9	14	19	23	28
ETHEPHON						
280 g/hectare	23.22	43.25b	93.23ab	148.32a	171.39a	193.84a
560 g/hectare	22.37	43.31b	81.83b	127.84b	142.72b	173.82b
1120 g/hectare	23.56	48.21a	89.30ab	140.56ab	160.65ab	185.18ab
Control	22.92	42.08b	96.36a	139.39ab	162.95ab	187.85ab
GLYPHOSATE						
67.2 g/hectare	22.78	41.79a	87.87a	139.33ab	167.05a	193.09a
134.4 g/hectare	22.39	33.91b	67.83b	124.25c	151.45ab	178.16ab
224 g/hectare	22.61	30.17b	56.86b	110.85c	141.60b	167.63b
Control	22.92	42.08a	96.36a	139.39a	162.95a	187.85a
MEFLUIDIDE						
280 g/hectare	24.91	46.21a	96.08a	147.62a	169.27a	197.88a
560 g/hectare	23.03	39.18b	82.67b	138.61a	163.45a	192.66a
1120 g/hectare	23.51	31.59c	53.89c	121.54a	147.64b	175.57b
Control	22.92	42.08ab	96.36a	139.39b	162.95a	187.85ab
Coefficient of variation	4.58%	8.22%	12.59%	6.92%	6.79%	5.95%

Means within the same column for each growth regulator which are followed by the same letter are not significantly different at the 5% level of probability as determined by the Bayes Least Significant Difference Test.

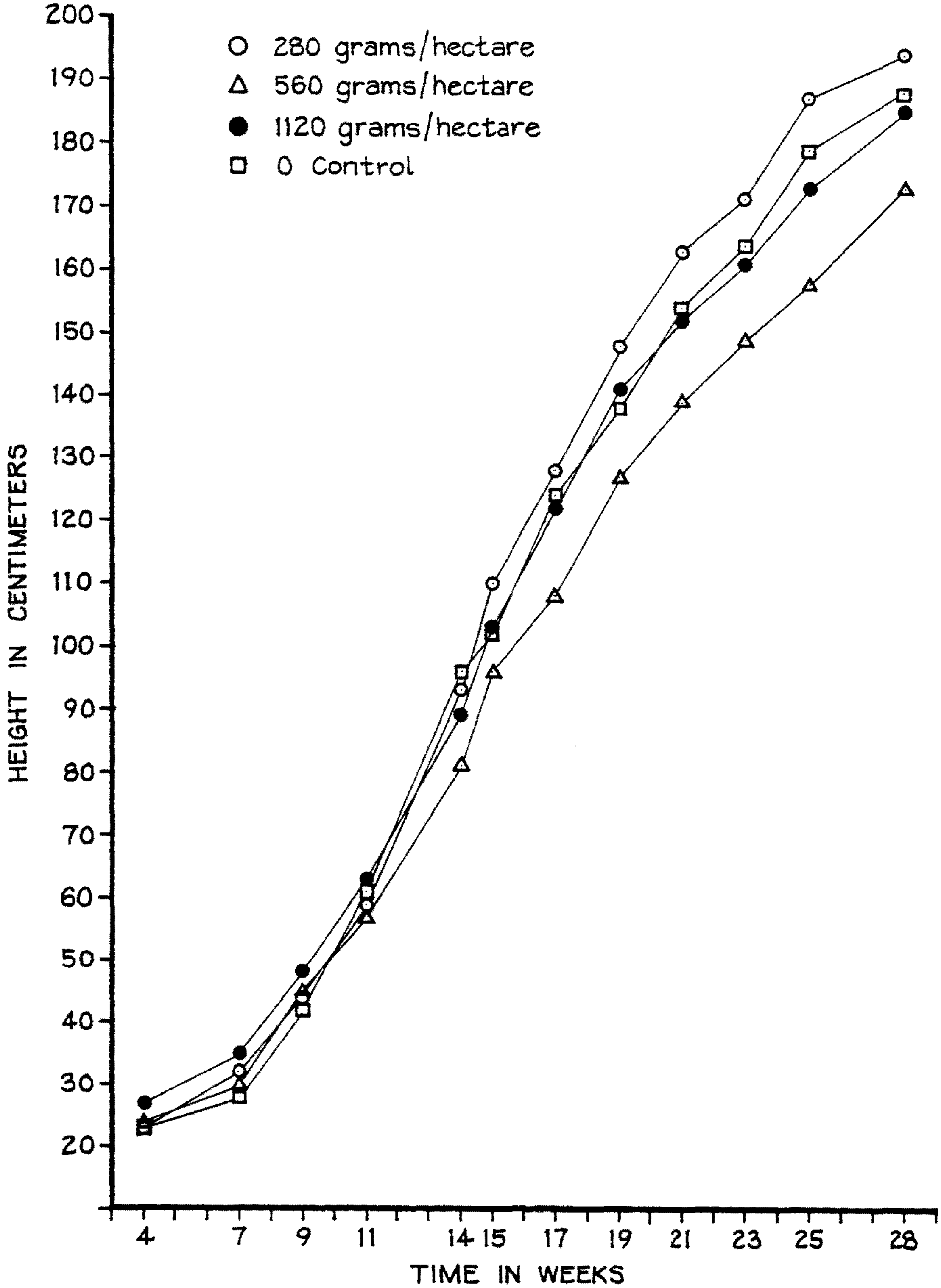

Fig. 4 Effect of Ethephon on Stalk-Height of Sugarcane Cultivar H62-4671

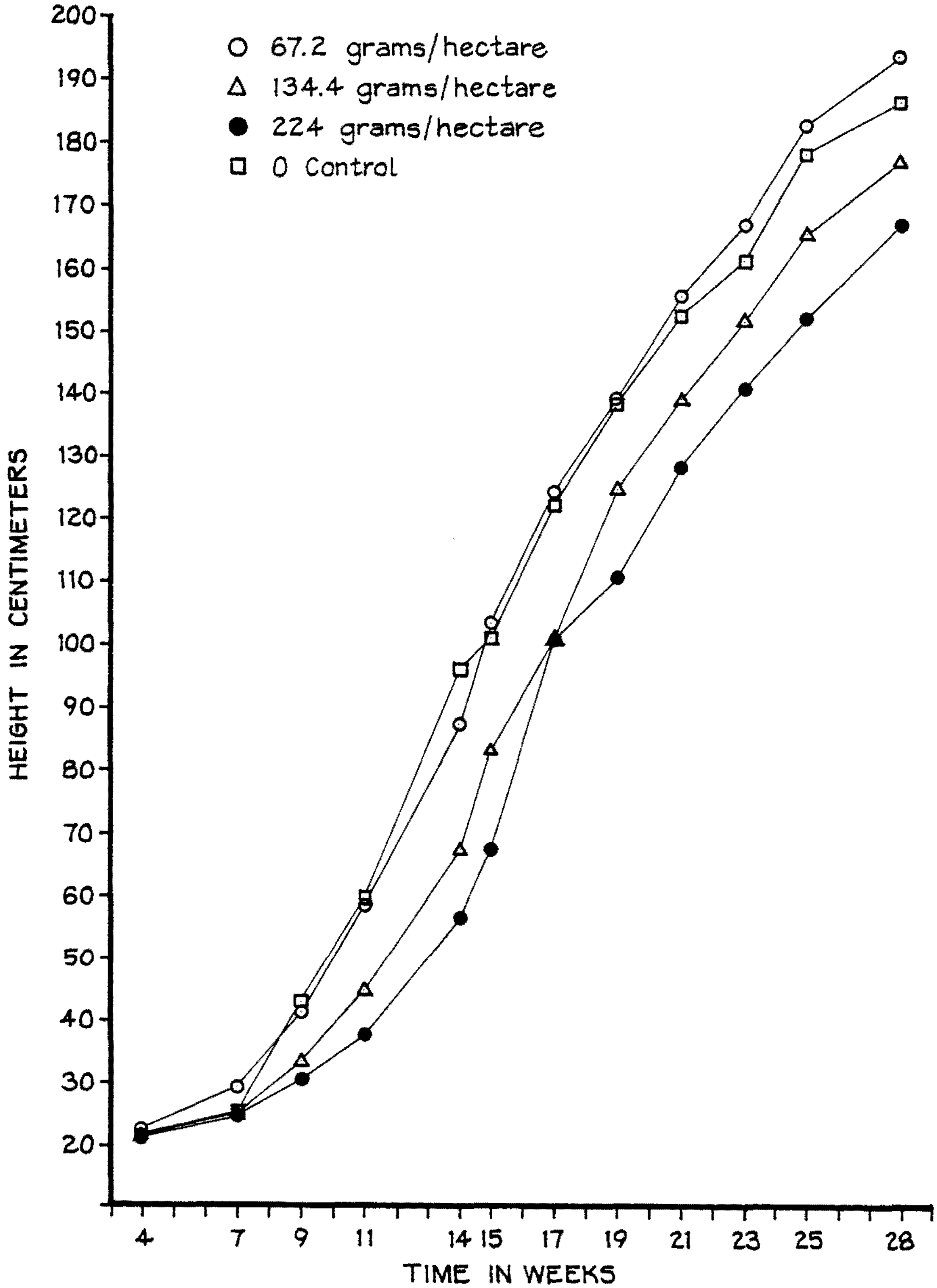

Fig. 5 Effect of Glyphosate on Stalk-Height of Sugarcane Cultivar H62-4671

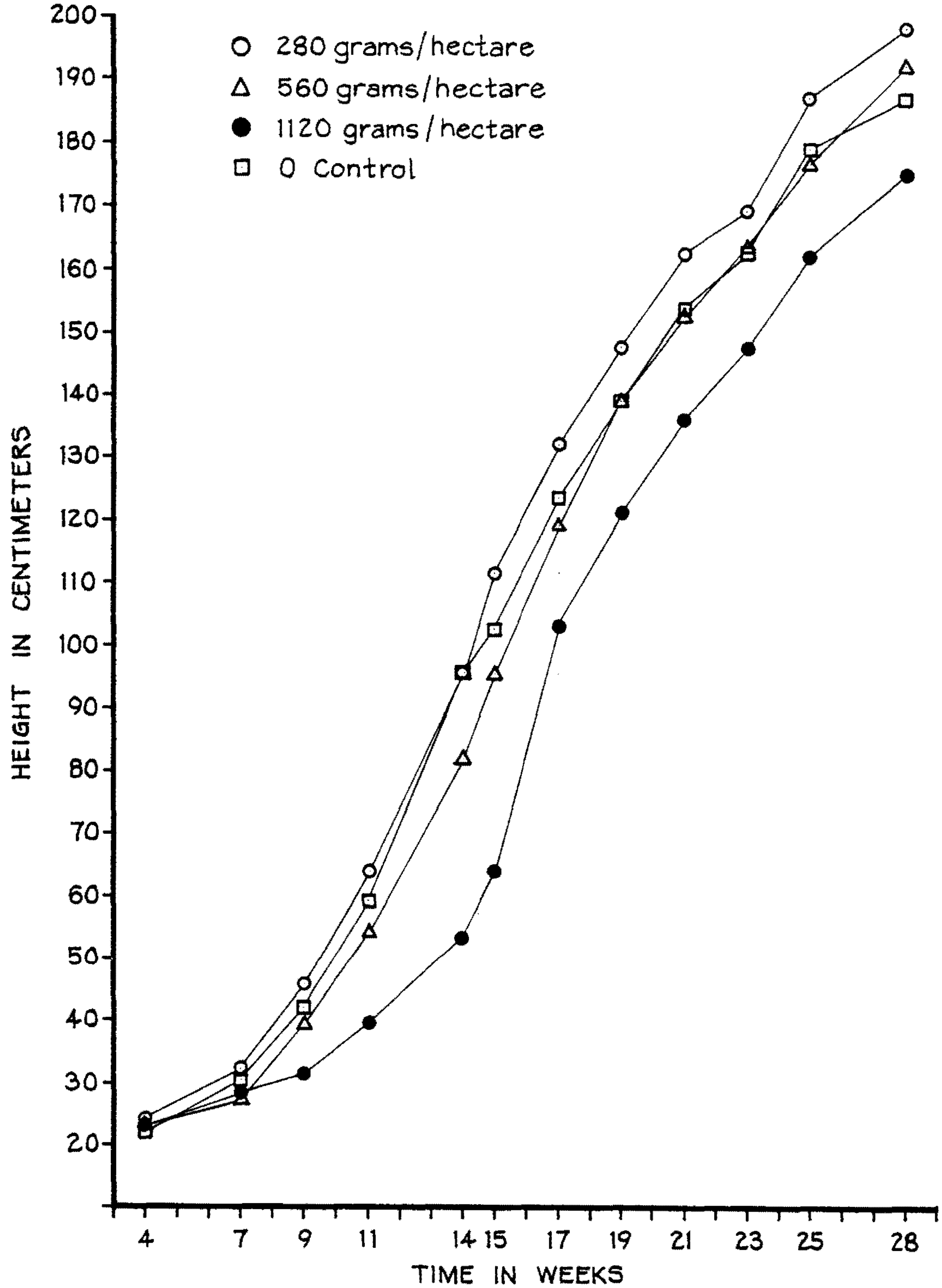

Fig. 6 Effect of Mefluidide on Stalk-Height of Sugarcane Cultivar H62-4671

The greatest stalk height increment was brought about by mefluidide at 280 g/hectare, followed by ethephon at the same rate and last was glyphosate at 67.2 g/hectare. Glyphosate at 224 g/hectare accounted for the lowest total height increment (Appendix, Table 18.) Relatively better stalk growth was illicited by mefluidide, followed by ethephon and last was glyphosate.

NUMBER OF GREEN LEAVES PER PRIMARY STALK

Ethephon treatments at 1120 g/hectare initially significantly increased the number of green leaves per primary stalk over the control. This trend changed from the 19th week, when the number of leaves accounted for by this treatment dropped. Generally, there wasn't a consistent trend in leaf number with the other rates of ethephon (Table 4, Appendix Figures 7,8 and 9).

Glyphosate on the other hand significantly reduced the number of green leaves per primary stalk at the highest rate from nine weeks after planting to the 23rd week (Table 16). In general, glyphosate, initially at the two highest rates and at the 19th week at the highest rate, reduced leaf number per stalk below that of the control. Mefluidide treatments also decreased leaf number per stalk relative to the control, and leaf numbers were comparable to those on plants treated with glyphosate (Table 4). Ethephon generally gave better response to leaf number per stalk than mefluidide and glyphosate.

TABLE 4. -- Effects of growth regulators on the number of green leaves per primary stalk of sugarcane cultivar H62-4671. Values are means of five replications.

TREATMENT RATE	Time in Weeks after Planting 4*	9	14	19	23	28
ETHEPHON:						
280 g/hectare	5.97	10.90b	13.79bc	14.76a	15.71a	13.78a
560 g/hectare	6.10	11.36ab	14.95ab	13.60b	13.60c	13.91a
1120 g/hectare	6.13	11.83a	15.08a	13.70ab	14.50bc	14.38a
Control	6.28	11.03b	13.08c	14.65a	14.88ab	13.95a
GLYPHOSATE:						
67.2 g/hectare	6.20	11.10a	13.44a	14.40a	15.00a	14.55a
134.4 g/hectare	6.13	9.83b	11.53b	14.03a	14.64a	14.36a
224 g/hectare	6.25	8.58c	10.10c	12.25b	13.17b	13.52a
Control	6.28	11.03a	13.08a	14.65a	14.88a	13.95a
MEFLUIDIDE:						
280 g/hectare	6.40	11.43a	14.03a	14.87a	15.38a	14.45a
560 g/hectare	6.43	10.35a	12.88a	13.90a	14.49a	14.32a
1120 g/hectare	6.62	8.60b	10.00b	12.14b	13.83b	14.07a
Control	6.28	11.03a	13.08a	14.65a	14.88a	13.95a
Coefficient of Variation	4.36%	5.12%	7.24%	5.59%	5.23%	4.20%

Means within the same column for each growth regulator which is followed by the same letter are not significantly different at the 5% level of probability as determined by Bayes Least Significant Difference Test.

* Data taken before treatment

A heavy storm hit the field a few days before the last count of leaves was taken at the 28th week. The lack of significant treatment effects could have been due to storm damage or to the fact that treatment effects did not persist for the entire 28 weeks. The number of significant differences due to treatment did diminish with time.

Light transmission through the canopy (Table 19) was not affected by treatments. However, cane treated with ethephon had less light transmission through the canopy than glyphosate and mefluidide treatments. This could be due to the increased number of leaves per stalk at the higher rate of ethephon (Appendix, Fig. 7).

STALK DIAMETER

The diameter of the 13th internode of ten primary stalks was measured at the 21st and 27th week after planting to ascertain the effect of growth regulators on stem size. The diameter of the 13th internode of the treated cane generally was reduced compared to the control (Table 5). All ethephon treatments significantly reduced stalk diameter relative to the control at both the 21st and 27th week of growth, though diameters generally were reduced by only 0.1 to 0.3 cm. Stalk diameter decreased significantly with increasing rates of glyphosate and mefluidide at the 21st week after planting. At 27th week of growth, only the highest rates of glyphosate and mefluidide resulted in a significant reduction in stalk diameter. Overall stalk-diameter was

TABLE 5. -- Effects of ethephon, glyphosate and mefluidide on stalk-diameter of sugarcane cultivar H62-4671 in cm, measured at the 13th internode. Values are the means of five replications.

RATE OF TREATMENT	Stalk diameter, cm	
	Weeks after planting	
	21	27
ETHEPHON:		
280 g/hectare	2.23b	2.29b
560 g/hectare	2.11b	2.19b
1120 g/hectare	2.07b	2.12b
Control	2.40a	2.41a
GLYPHOSATE:		
67.2 g/hectare	2.35a	2.34a
134.4 g/hectare	2.16b	2.30a
224 g/hectare	1.94c	2.10b
Control	2.40a	2.41a
MEFLUIDIDE:		
280 g/hectare	2.40a	2.39a
560 g/hectare	2.24b	2.32a
1120 g/hectare	2.04c	2.16b
Control	2.40a	2.41a
Coefficient of variation	4.41%	3.33%

Means within the same column for each growth regulator which are followed by the same letter are not significantly different at the 5% level of probability as determined by Bayes Least Significant Difference Test.

reduced more by glyphosate, followed by ethephon, and last by mefluidide.

BREEDERS GRADING OF PLOTS

Subjective grading of the plots for stand and appearance (Appendix, Table 20) showed that only ethephon at 280 g/hectare gave a better grade relative to the control. Mefluidide at 1120 g/hectare had the worst grade, followed by glyphosate at the same rate.

STALK WEIGHT OF CANE

The average weight of stalks, excluding the tops above the growing point, were obtained from a sampling area of 3m by 3m plot at harvest, using a spring balance. The only treatment which significantly increased the stalk weight of cane was the low rate of ethephon (280 g/hectare). Overall, the lowest weights were obtained with glyphosate followed by mefluidide (Table 6).

POL PERCENT CANE

None of the chemicals used had a significant effect on the quality of cane measured as pol percent cane. However, the control had a consistently higher percentage of pol than the chemically treated cane (Table 7). Complete analysis of the juice is given in Table 21 of the Appendix.

TABLE 6. -- Effect of ethephon, glyphosate and mefluidide on weight of stalks per plot (3m x 3m) of sugarcane cultivar H62-4671 at 28 weeks after planting.

TREATMENT RATE	WEIGHT OF STALKS PER PLOT (KG)
ETHEPHON:	
280 g/hectare	78.94 a
560 g/hectare	57.39 b
1120 g/hectare	60.34 b
Control	61.14 b
GLYPHOSATE	
67.2 g/hectare	61.91 a
134.4 g/hectare	50.91 a
224 g/hectare	51.59 a
Control	61.14 a
MEFLUIDIDE:	
280 g/hectare	64.77 a
560 g/hectare	67.84 a
1120 g/hectare	56.27 a
Control	61.14 a
Coefficient of variation	15.37 %

Means within the same column for each growth regulator which are followed by the same letter are not significantly different at the 5% level of probability as determined by the Bayes Least Significant Difference Test.

TABLE 7. -- The effect of ethephon, glyphosate and mefluidide on pol percent cane of sugarcane cultivar H62-4671.

TREATMENT RATE	POL PERCENT CANE
ETHEPHON:	
280 g/hectare	6.67a
560 g/hectare	7.54a
1120 g/hectare	6.84a
Control	8.09a
GLYPHOSATE:	
67.2 g/hectare	7.26a
134.4 g/hectare	7.25a
224 g/hectare	6.64a
Control	8.09a
MEFLUIDIDE:	
280 g/hectare	6.53a
560 g/hectare	7.32a
1120 g/hectare	6.61a
Control	8.09a
Coefficient of variation	11.47%

Means within the same column for each growth regulator which are followed by the same letter are not significantly different at the 5% level probability as determined by the Bayes Least Significant Difference Test.

V. DISCUSSION

The visual symptoms observed in the treated cane on the upper part of the field weren't noticed in the lower part of the field, the good growth area. Generally there was little or no treatment effect in the ten plots. It appears that vigorously growing cane plants respond to growth regulators differently from the stressed ones. In this case, the cane in the upper part of the field was presumed to be poorly aerated due to the high frequency of irrigation and a greater level of compaction (Appendix, Table 16).

From the results reported here it is evident that the three growth regulators used initially suppressed growth of primary stalks, followed by a flush of tillers. Short term suppression of growth is probably due to the effect of the three chemicals on the apical meristem. The observed inhibition of growth of primaries and the flush of tillers is in agreement with the finding of Caseley (1972); and Coupland and Caseley (1975) who reported that sublethal doses of glyphosate applied to the foliage of Agropyron repens stopped the growth of existing shoots completely and caused prolific tillering. Similar responses on sugarcane were observed by Anon.,(1978) and Buenaventura and Rosario (1978), who used ethephon and mefluidide respectively. Generally the above effects were similar to those observed when glyphosate and glyphosine were used to ripen cane, spindle growth ceases temporarily, thus weakening the apical dominance.

The loss of apical dominance resulted in the growth of axillary buds immediately below the apex (Osgood and Teshima, 1979).

In terms of percentage increase in tiller number relative to the control(Table 1) there was an indication that the ethephon and mefluidide consistently improved tiller production of cultivar H62-4671 more than glyphosate. This probably was due to herbicidal effects of glyphosate on plants, particularly at the higher rates of application. This is supported by the results of Baur and Bovey,(1975) who demonstrated that higher rates of glyphosate caused substantial decrease in growth and the subsequent death of the treated sorghum plants.

In general the number of tillers per foot (30.5cm) of row produced during the 28 weeks increased with time up to the 15th week of growth, and thereafter declined due to inter- and intra-culm competition for light. This was more evident after the 15th week of growth when the canopy closed in. Most of the dead stalks were the young tillers which were shaded by the vigorous older stalks. Some primary stalks also died due to the herbicidal effect of the chemicals, especially the higher rates of glyphosate and mefluidide and particularly in the early stages of growth.

Although plants treated with ethephon and mefluidide at 1120 g/hectare had relatively higher numbers of tillers than were observed at lower rates, they had a correspondingly higher rate of tiller mortality, so the number of the surviving tillers was not significantly different among the treatments. Similar results were reported by Buenaventura and Rosario, (1978) using mefluidide and bualta (polyoxyethylene dimethyliminio ethylene dichloride).

The stimulation of growth in height by the lower rates of the three chemicals used in this experiment was similar to the classical growth regulator effect: promotion of growth at low levels and inhibition of growth at high levels (Thimann, 1937; and Baur and Bovey, 1977). Similar results were obtained by Maretzki, et al., (1976), who applied different concentrations of glyphosate to cane and observed that at low concentrations the internodes were elongated, while at higher concentrations there was growth inhibition. In addition, the substantial increase in height of stalk achieved by ethephon at 280 g/hectare in this experiment agrees with results obtained by Rostron (1974) and Teshima (1979) who reported ethephon and glyphosine produced large and statistically significant increases in the length of internodes of certain South African and Hawaiian sugarcane varieties, respectively. However, it should be noted that length of internodes wasn't measured in this experiment. The assumption is that the greater height due to treatment resulted from a greater internode length. The increase in cane height may have potential value in seedcane production if the increase in stalk length results in part from a greater number of nodes.

Leaf number was counted to determine the relationship between treatment and the rate of leaf canopy development. The positive response of leaf number per primary stalk to ethephon in the early stages of growth agrees with the findings of Eastwood, (1979) who reported that although ethephon reduced the total leaf-blade mass per primary shoot, it did enhance the number of green leaves at seven weeks after treatment. However, other work with ethephon as a ripener (Rostron, 1974) showed that neither ethephon nor glyphosine had any effect on the total number of leaves per stalk. The difference in response was probably due to varietal differences. van Andel, (1970) observed that cultivars of some plant species differed considerably in sensitivity to ethephon.

The difference in response of the number of green leaves per stalk to ethephon could also be an effect of time of application. Treatments in this experiment and that of Eastwood (1979) were done in the early stages of growth while Rostron (1974) applied ethephon to mature cane near the time of harvest. It is probable the large number of leaves present in the later stages of growth in Rostron's (1974) experiment would intercept more growth regulators, thus suppressing the leaf growth. In this study and that of Eastwood (1979) the small sparsely spaced leaves would intercept much less growth regulator. An increase in the number of leaves at this early growth stage could absorb more sunlight and thus hasten the establishment of the stand. In addition, early leaf development would help control weeds.

In another experiment Baur and Bovey (1975) reported that glyphosate treated sorghum plants had more foliage than normal. This differs from the results of this experiment, where glyphosate treatments reduced the number of green leaves per stalk relative to the control. However the results obtained in this experiment seem more consistent with the effect of glyphosate on other growth parameters including the number of tillers, height of stalks and stalk diameter.

The consistent decrease in stalk diameter following application of ethephon, glyphosate and mefluidide to H62-4671 are in contrast to the results obtained by Buenaventura and Rosario, (1978) who reported no significant differences in stalk-diameter among mefluidide and bualta treatments of sugarcane c.v. phil. 52-226. The difference in results could be due to the environmental conditions and differential varietal sensitivity to the given growth regulators. Reduced stalk size is popular with seedcane cutters, therefore the smaller the stalks, the more efficiency of seedcane cutting by hand (personal communication with plantation agriculturists in Hilo, Hawaii.) In addition small stalk diameters would reduce the seed tonnage, which is a saving in terms of transport cost. However, it should be noted that cuttings from very thin stalks produce poor stands, which ultimately produce poor yields. (H.S.P.A. 1968, unpublished report.

The improvement in the average fresh cane weight given by the lower rate of ethephon, is in agreement with the findings of Rostron (1974) who reported that ethephon consistently increased internode and average stalk weight of certain sugarcane varieties in South Africa. In addition Baur and Bovey (1975) observed significant increases in average fresh weight of sorghum seedlings that had been treated with relatively low levels of glyphosate. Similar observations were made by Coupland and Caseley (1975) who reported that sublethal doses of glyphosate to Agropyron repens significantly increased fresh weight over the control plants. Also, Poovaiah and Leopold (1973) reported that low rates of ethephon significantly increased the fresh weight of grasses.

The 30% increase in stalk weight over the control at the lowest rate of ethephon (280 g/hectare) could increase the quality of seed produced, for as Singh and Ali (1974) observed thick and healthy canes containing adequate water and food reserves should be selected for planting so as to enhance germination.

The results of the sugar analyses (Table 21) are in contrast with results obtained when the same chemicals were used as ripeners; as ripeners they reduced the size of stalks, but increased the accumulation of sucrose (Osgood and Teshima, 1979). The lack of an effect on sucrose accumulation is probably due to the fact that the chemicals were applied at an early stage of growth.

Tables 8 and 9 show the overall effects of growth regulators to various growth parameters, some of which have direct influence on the quality and quantity of seedcane. Considering the quantity (seedcane-yield), tiller number and stalk-height are directly involved, and the best treatment combining the two was ethephon at 280 g/hectare, followed by mefluidide at the same rate. Essentially the best measure could have been stalks/m^2 x number of nodes per stalk, however, the number of nodes per stalk wasn't counted in this experiment.

Seedcane quality on the other hand is influenced by stalk-diameter, internode length (stalk height in this case) and weight. Here again ethephon treatment gave the best response followed by mefluidide at the same rate. It should, however, be noted that too long and too short internodes are just as undesirable as are very small diameter of stalks. Too long a stalk or internode would be lacking in sufficient number of buds, per unit of length, whereas too short internodes and very small stalks would be lacking in sufficient food reserve and moisture to establish a good stand in the early stages of growth.

TABLE 8. -- Summary of tiller number, stalk height and number of leaves of Sugarcane cultivar H62-4671 at 14 weeks after planting.

Treatment Rate	Tiller Number *	Stalk Height (cm)	No. Leaves/ Stalk
ETHEPHON;			
280 g/hectare	2.96ab	93.23ab	13.79bc
560 g/hectare	2.92ab	81.83b	14.95ab
1120 g/hectare	3.34a	89.30ab	15.08a
Control	2.51b	96.36a	13.08c
GLYPHOSATE:			
67.2 g/hectare	2.55a	87.87a	13.44a
134.4 g/hectare	2.67a	67.83b	11.53b
224 g/hectare	2.87a	56.86b	10.10c
Control	2.51a	96.36a	13.08a
MEFLUIDIDE:			
280 g/hectare	2.71b	96.08a	14.03a
560 g/hectare	3,06ab	82.67b	12.88a
1120 g/hectare	3,55a	53.89c	10.00b
Control	2.51b	96.36a	13.08a

Means within the same column for each growth regulator which is followed by the same letter are not significantly different at 5% level of probability as determined by Bayes Least Significant Difference Test.

* per foot (30.5 cm) of row

TABLE 9. -- Summary of tiller number, stalk height, diameter of stalk, weight of cane and pol percent of sugarcane cultivar H62-4671 at 28 weeks after planting

Treatment Rate	Tiller Number *	Stalk Height (cm)	No. Leaves/ Stalk	Diameter of Stalk	Wt of Cane/** Plot, kg	Pol Percent Cane
ETHEPHON:						
280 g/hectare	1.44a	193,84a	13.78a	2,29b	78.94a	6.67a
560 g/hectare	1.43a	173.82b	13,91a	2.19b	57.39b	7.54a
1120 g/hectare	1.50a	185.18ab	14.38a	2,12b	60.34b	6.84a
Control	1.29a	187.85ab	13,95a	2.41a	61.14b	8.09a
GLYPHOSATE:						
67.2 g/hectare	1.24a	193.09a	14,55a	2,34a	61.91a	7.26a
134.4 g/hectare	1.28a	178.16ab	14,36a	2.30a	50.91a	7,25a
224 g/hectare	1.38a	167.63b	13.52a	2,10b	51.59a	6.64a
Control	1,20a	187.86a	13,95a	2,41a	61.14a	8.09a
MEFLUIDIDE:						
280 g/hectare	1.30a	197.88a	14.45a	2.39a	64.77a	6.53a
560 g/hectare	1,42a	192.55a	14.32a	2.32a	67.84a	7.32a
1120 g/hectare	1,64a	175.57b	14.07a	2.16b	56.27a	6.61a
Control	1.29a	187.85ab	13,95a	2.41a	61.14a	8,09a

Means within the same column for each growth regulator which is followed by the same letter are not significantly different at 5% level of probability as determined by Bayes Least Significant Difference Test.

* per foot (30.5 cm) of row

** 3x3 m sampling area

VI. SUMMARY AND CONCLUSION

A field experiment was conducted to determine the effect of the growth regulators ethephon, glyphosate and mefluidide on the early growth and development of sugarcane cultivar H62-4671. The variables included were: (a) ethephon applied at 280, 560, and 1120 g/hectare; (b) glyphosate applied at 67.2, 134.4 and 224 g/hectare, and (c) mefluidide applied at 280, 560 and 1120 g/hectare. Results indicated that higher rates of the three chemicals initially significantly improved tiller number per foot of row (30.5cm) but little or no significant difference among the treatments was measured at harvest. Low concentrations of ethephon and mefluidide stimulated growth in height of the stalks with the greatest height accounted for by ethephon at 280 g/hectare. Only ethephon at 1120 g/hectare significatly increased the number of green leaves per primary stalk while glyphosate and mefluidide at the highest rates significantly reduced green leaf number. Generally stalk diameter decreased significantly with increasing rates of the three chemicals. A significant increase in stalk weight was only obtained by the low rate of ethephon (280 g/hectare). None of the chemicals used had a significant effect on the pol percent cane.

The general conclusions derived from this experiment are that lower rates of the three growth regulators improved the growth and the subsequent weight of the sugarcane stalks, while the higher rates stimulated tiller production but reduced stalk diameter and the number of green leaves per primary stalk. However, the lack of consistent responses to treatment in some instances demonstrates a need for further experimentation to determine more precisely the optimum timing and rate of application for a given sugarcane crop. Future experiments should include measurements of the total linear length of stalk and internode length as these are important parameters in seedcane production not measured in this experiment. In addition, various spacings should be tried to establish the right plant populations at which the rate of tiller produciton would be maximized. It would also be of interest to follow up the cause of differential response of the stressed and the vigorously growing sugarcane plants to the growth regulators used in this experiment. The lack of visible symptoms to relatively high rates of growth regulator in the vigorously growing plots indicates a need to study the effects of treatment rate on both stressed and non-stressed plants.

APPENDIX

TABLE 10. -- Temperature, degrees Celsius, at Kunia substation, Oahu, Hawaii.

YEAR	MONTH	MAXIMUM	MINIMUM	MEAN
1979	June	28.0	18.4	23.2
	July	29.2	18.3	23.7
	August	30.5	18.9	24.7
	September	30.7	19.3	25.0
	October	29.5	19.7	24.6
	November	27.8	17.8	22.8
	December	27.2	16.9	22.1
1980	January	26.5	15.9	20.7

TABLE 11. -- Rainfall (in mm), Kunia Substation, Oahu, Hawaii

YEAR	MONTH	AMOUNT IN (MM)
1979	June	50
	July	3
	August	5
	September	10
	October	28
	November	18
	December	53
1980	January	338

TABLE 12. -- Day degrees, Kunia Substation, Oahu, Hawaii
(Calculated by subtracting 70°F from the daily maximum temperature).

DATE	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN. 1980
1	13.0	13.0	16.5	19.0	17.5	12.5	15.0	9.0
2	13.5	14.0	13.0	18.0	15.5	9.0	17.0	8.0
3	13.0	12.0	15.5	17.0	16.5	14.0	9.0	8.0
4	12.0	13.5	16.0	16.0	17.5	13.0	8.5	9.0
5	12.0	14.0	15.0	13.5	16.5	15.0	5.0	8.0
6	12.0	14.0	15.0	18.0	16.0	14.5	8.0	8.0
7	14.0	11.0	17.6	18.0	16.0	15.0	12.0	5.0
8	12.5	11.0	17.5	18.0	14.0	16.0	15.0	8.5
9	13.0	15.0	17.0	17.0	15.5	11.0	13.0	6.0
10	14.5	17.0	17.5	17.0	16.5	10.0	10.0	10.0
11	12.0	14.0	19.0	19.0	17.5	10.0	12.0	0.0
12	11.0	14.5	18.0	19.0	18.0	10.5	13.0	8.0
13	11.0	15.0	16.5	18.0	17.5	13.5	13.0	10.0
14	11.0	16.0	17.0	17.5	17.0	11.0	10.5	10.0
15	14.0	19.5	17.0	16.0	17.5	9.5	9.0	11.0
16	11.0	13.0	18.0	18.0	17.0	10.5	11.0	12.0
17	11.5	18.0	18.0	19.0	16.5	10.0	12.0	12.0
18	11.0	13.0	17.0	17.5	9.0	11.0	12.5	11.0
19	12.5	14.0	18.0	19.5	6.0	12.0	12.0	9.5
20	13.5	16.5	18.0	17.0	6.0	13.0	14.0	9.0
21	11.0	17.0	18.0	17.0	13.0	12.0	14.0	10.0
22	13.0	15.0	17.0	17.0	15.0	13.0	12.0	7.0
23	14.0	13.0	17.5	16.0	16.5	16.0	9.0	3.0
24	11.0	15.0	16.0	17.5	15.0	13.0	12.0	4.0
25	10.0	14.0	17.0	15.0	14.0	14.0	7.0	4.5
26	12.0	15.0	17.0	17.0	15.0	8.0	9.0	5.0
27	14.0	13.0	16.0	16.0	16.0	6.0	9.0	8.0
28	12.5	13.5	16.0	16.5	15.0	10.0	10.0	7.0
29	14.0	14.0	17.0	16.0	15.0	12.0	8.0	9.0
30	11.0	16.5	18.0	17.0	13.5	15.0	7.0	9.0
31		16.5	19.0		17.0		9.0	8.0
TOTAL	370.5	450.5	523.50	517.00	468.50	472.50	337.50	246.5
MEAN	12.5	14.53	16.89	17.23	15.11	15.75	10.89	7.95

TABLE 13. -- Radiation in Langleys, Kunia Substation, Oahu, Hawaii.

DATE	1979 JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	1980 JAN.
1	522.2	451.5	432.6	428.0	268.2	247.3	388.8	352.4
2	604.1	438.5	418.9	505.4	322.1	394.4	297.7	426.6
3	548.7	578.7	451.9	423.4	511.5	441.9	371.4	393.0
4	529.8	570.0	561.4	341.0	464.7	462.5	282.7	308.4
5	521.9	488.1	612.9	412.0	392.9	418.1	216.7	290.4
6	520.7	403.0	430.5	419.6	429.0	413.4	270.3	189.2
7	345.1	577.2	454.0	595.0	341.0	385.7	393.9	266.1
8	553.7	560.9	483.5	550.2	301.3	397.3	399.4	-
9	581.7	547.1	496.2	361.8	389.3	298.0	255.8	-
10	493.7	565.4	540.0	484.0	533.9	240.7	301.7	-
11	489.1	576.1	436.9	469.2	475.5	305.7	382.8	352.7
12	488.6	646.4	602.5	530.3	410.7	368.5	366.1	358.2
13	443.8	561.9	423.9	528.8	369.5	292.2	283.2	407.6
14	586.3	580.7	536.9	490.1	498.8	293.0	265.0	294.8
15	368.5	324.2	397.0	532.4	500.9	422.4	299.1	322.3
16	305.4	497.8	421.2	570.5	430.6	445.5	336.0	415.8
17	457.5	319.6	577.7	556.3	228.0	364.5	379.3	288.2
18	420.4	496.2	460.6	489.6	344.0	314.6	418.4	404.1
19	576.1	556.8	380.2	579.7	349.6	362.4	412.6	460.1
20	436.7	626.0	572.1	447.9	364.9	424.5	394.4	308.8
21	541.0	582.8	588.4	486.6	453.0	444.5	301.2	304.6
22	553.2	300.3	588.9	507.9	350.1	352.4	258.7	357.7
23	481.0	270.0	427.9	516.1	335.9	373.8	378.5	390.9
24	511.5	504.4	405.4	376.1	308.4	403.6	247.3	343.7
25	427.0	605.7	469.8	546.6	457.0	336.8	396.2	432.6
26	572.1	492.7	505.4	534.9	425.5	327.3	307.2	437.9
27	528.3	565.4	371.0	516.1	308.4	326.5	378.5	219.1
28	510.0	499.8	525.2	493.7	342.0	247.8	226.2	206.1
29	242.7	441.7	448.8	456.5	250.9	295.6	244.2	285.6
30	267.2	462.1	517.1	401.6	378.6	376.7	304.1	254.2
31		574.6	618.4		298.2		436.1	223.8
MEAN	484.3	522.1	511.8	491.7	381.2	359.3	328.8	332.0

TABLE 14. -- Analysis of crop log samples of sugarcane cultivar H62-4671 for nutrients, water and total sugar at 2.3 months of age.

Treatment	Plot	Avg. Sheath Wt/Stk Grams	Sheath H_2O	Blade N	P-IX.	K-IX.	Ca-IX.	Total Sugar	K-H_2O
					Percent				
Check	X 02	79.4	87.0	2.06	0.107	2.77	0.24	15.6	0.34
	04	66.0	86.7	1.90	0.129	3.24	0.24	15.0	0.42
	18	79.4	86.9	2.04	0.148	3.13	0.23	13.3	0.41
	35	73.2	81.7	2.10	0.150	3.42	0.24	11.2	0.45
	41*	88.8	88.3	2.06	0.154	4.02	0.23	10.6	0.47
	Avg.	77.3	87.1	2.03	0.138	3.32	0.24	13.1	0.42
Ethephon 280 g/ hectare	A 23	49.6	88.4	2.30	0.176	3.87	0.26	12.3	0.44
	26	58.4	87.5	2.18	0.158	3.41	0.26	12.2	0.42
	34	57.6	88.3	2.22	0.168	3.78	0.25	12.2	0.43
	49*	71.2	89.1	2.44	0.145	4.37	0.25	9.9	0.47
	50*	67.7	88.7	2.34	0.162	4.26	0.25	10.0	0.48
	Avg.	60.8	88.4	2.29	0.162	3.94	0.25	11.3	0.45
Ethephon 560 g/ hectare	B 03	42.6	87.5	2.00	0.152	3.23	0.23	13.4	0.39
	11	48.0	87.5	2.14	0.142	3.76	0.26	11.8	0.46
	36	59.0	88.6	2.46	0.191	3.58	0.25	11.2	0.40
	37	36.8	83.4	2.52	0.170	3.95	0.27	11.4	0.69
	42*	40.6	83.4	2.52	0.171	4.20	0.25	10.6	0.74
	Avg.	86.0	86.0	2.32	0.165	3.74	0.25	11.6	0.54

IX = index, denoting elements in sugar free sample
* = Plots in lower field, the good growth area

TABLE 14. -- (Continued) Analysis of crop log samples of sugarcane cultivar H62-4671 for nutrients, water and total sugar at 2.3 months of age.

Treatment	Plot	Avg. Sheath Wt/Stk Grams	Sheath H_2O	Blade N	P-IX.	K-IX.	Ca-IX.	Total Sugar	$K-H_2O$
						Percent			
Ethephon 1120 g/ hectare	C 21	39.2	88.5	2.54	0.179	3.84	0.26	11.0	0.44
	27	40.8	88.7	2.60	0.180	3.76	0.25	9.6	0.42
	29	44.0	88.5	2.56	0.191	3.91	0.25	11.1	0.45
	38	34.8	88.3	2.74	0.223	4.02	0.25	11.0	0.47
	46*	58.0	89.6	2.56	0.158	4.69	0.27	8.7	0.49
	Avg.	43.3	88.7	2.59	0.186	4.04	0.26	10.2	0.46
Glyphosate 67.2 g/ hectare	D 09	63.0	87.5	2.28	0.130	3.45	0.26	13.6	0.42
	17	38.4	87.9	2.34	0.148	3.54	0.27	14.2	0.42
	20	72.4	88.2	2.38	0.142	4.02	0.26	11.0	0.47
	25	38.0	88.2	2.64	0.172	3.70	0.28	11.9	0.43
	33	51.2	88.5	2.34	0.181	3.56	0.28	11.8	0.40
	Avg.	68.5	88.0	2.39	0.155	3.65	0.27	12.0	0.43
Glyphosate 134.4 g/ hectare	E 01	64.0	87.8	2.34	0.134	3.98	0.30	12.1	0.48
	13	55.8	88.6	2.38	0.147	4.11	0.30	11.5	0.46
	22	45.0	88.5	2.28	0.182	3.65	0.28	13.2	0.41
	44*	67.2	89.4	2.56	0.152	4.32	0.28	9.1	0.46
	45*	44.8	84.3	2.38	0.174	4.20	0.27	10.6	0.70
	Avg.	57.5	87.7	2.38	0.162	4.05	0.29	11.2	0.50

* Plots in lower field, the good growth area.
IX = index, denoting elements in sugar free sample

TABLE 14. -- (Continued) Analysis of crop log samples of sugarcane cultivar H62-4671 for nutrients, water and total sugar at 2.3 months of age.

Treatment	Plot	Avg. Sheath Wt/Stk Grams	Sheath H_2O	Blade N	P-IX.	K-IX.	Ca-IX.	Total Sugar	$K-H_2O$
Glyphosate	F 05	48.2	87.2	2.14	0.157	3.63	0.29	13.0	0.38
224 g/	12	48.3	85.5	2.46	0.169	3.91	0.28	12.6	0.58
hectare	14	48.2	88.4	2.54	0.173	3.83	0.23	12.3	0.44
	40	51.8	88.8	1.34	0.212	4.07	0.21	13.1	0.44
	43*	57.6	89.5	2.42	0.168	4.55	0.24	13.1	0.45
	Avg.	50.9	88.3	2.37	0.176	4.00	0.25	12.8	0.46
Mefluidide	G 15	72.0	87.6	2.30	0.150	3.55	0.21	12.3	0.44
280 g/	28	59.6	86.1	2.22	0.179	3.26	0.22	12.6	0.42
hectare	30	66.8	88.6	2.56	0.148	3.64	0.24	13.6	0.40
	32	66.2	88.0	2.64	0.170	3.61	0.22	12.1	0.43
	47*	81.0	88.8	2.62	0.134	4.34	0.23	9.6	0.49
	Avg.	69.1	88.0	2.46	0.158	3.68	0.22	12.0	0.44
Mefluidide	H 06	66.4	87.7	2.62	0.143	3.78	0.22	10.4	0.47
560 g/	07	58.8	87.2	2.28	0.111	3.28	0.23	12.4	0.42
hectare	31	65.6	88.4	2.54	0.169	3.60	0.22	11.0	0.41
	39	53.0	87.8	2.62	0.181	3.55	0.24	11.3	0.43
	48*	59.0	89.3	2.34	0.144	4.01	0.24	9.5	0.43
	Avg.	60.5	88.0	2.48	0.150	3.64	0.23	10.9	0.43

* Plots in lower field, the good growth area
IX - Index, denoting elements in sugar free sample

TABLE 14. -- (Continued) Analysis of crop log samples of sugarcane cultivar H62-4671 for nutrients, water and total sugar at 2.3 months of age.

Treatment	Plot	Avg. Sheath Wt/Stk Grams	Sheath H_2O	Blade N	P-IX.	K-IX.	Ca-IX.	Total Sugar	K-H_2O
					Percentage				
Mefluidide 1120 g/ hectare	I 08	42.0	87.8	2.24	0.135	3,25	0.23	10.7	0.40
	10	41.0	88,6	2.44	0.167	3,63	0.24	11.6	0.41
	16	49.9	88.8	2,36	0.191	4.11	0,22	12.6	0.45
	19	34.8	88,3	2.56	0.195	3.91	0.22	11.9	0.45
	24	49.4	88.9	2.50	0.191	4.21	0.23	11.1	0.46
	Avg.	43.4	88.4	2,42	0.176	3,82	0.23	11.5	0.43

IX. - index, denoting elements in sugar free sample

TABLE 15. -- Leaf sheath micronutrient contents of sugarcane cultivar H62-4671 at 2.3 months of age.

Treatment	Plot No.	Mn	Zn	Cu	Fe
		ppm			
Check	2-x	90.0	9.0	2.3	74.0
Check	4-x	112.0	7.4	2.0	108.0
Check	18-x	84.0	11.2	2.6	125.2
Check	35-x	82.0	18.4	2.5	110.0
Check	41-x*	101.2	12.6	3.0	109.6
	Avg.	93.8	11.7	2.6	105.4
Ethephon 280 g/hectare	23-A	96.5	10.8	2.9	94.0
	26-A	92.0	10.6	2.5	91.6
	34-A	84.0	13.0	3.2	92.4
	49-A*	73.6	15.4	4.2	88.0
	50-A*	78.8	17.0	5.1	84.8
	Avg.	85.0	13.4	3.6	90.2
Ethephon 560 g/hectare	3-B	72.0	9.0	3.0	101.6
	11-B	168.0	15.0	4.5	111.6
	36-B	86.8	13.4	3.3	207.0
	37-B	92.0	10.8	3.4	100.0
	42-B*	84.8	15.6	6.0	107.2
	Avg.	100.7	12.8	4.0	125.5
Ethephon 1120 g/hectare	21-C	166.0	12.6	5.3	88.8
	27-C	99.2	13.8	5.0	118.0
	29-C	125.2	13.0	5.5	295.0
	38-C	108.4	17.0	5.6	132.0
	46-C*	82.0	17.8	6.4	104.0
	Avg.	116.0	14.8	5.6	147.6
Glyphosate 67.2 g/hectare	9-D	158.4	6.4	2.3	166.2
	17-D	90.8	10.4	3.0	66.0
	20-D	165.2	8.8	3.5	84.8
	25-D	98.2	9.4	2.4	92.0
	33-D	92.8	10.4	3.0	120.0
	Avg.	121.0	9.1	2.8	105.8
Glyphosate 134.4 g/hectare	1-E	181.9	9.0	3.0	72.0
	13-E	201.6	13.2	3.6	111.6
	22-E	107.2	10.6	1.2	94.0
	44-E*	73.2	12.0	2.4	98.4
	45-E*	75.6	11.2	1.8	100.0
	Avg.	127.9	11.2	2.4	95.2

* Plots in the lower field, the good growth area

TABLE 15. (continued) Leaf sheath micronutrient contents of sugarcane cultivar H62-4671 at 2.3 months of age.

Treatment	Plot No.	Mn	Zn	Cu	Fe
		ppm			
Glyphosate 224 g/hectare	5-F	92.0	7.4	1.2	85.6
	12-F	101.6	7.6	1.6	106.0
	14-F	115.6	9.0	1.4	101.6
	40-F	116.0	12.0	1.4	89.2
	43-F*	82.8	13.2	6.0	128.4
	Avg.	101.6	9.8	2.3	102.2
Mefluidide 280 g/hectare	15-G	68.0	7.6	1.2	78.0
	28-G	74.0	6.4	0.8	66.0
	30-G	128.8	9.4	1.0	84.8
	32-G	92.0	8.4	1.8	100.8
	47-G*	70.0	10.6	2.0	97.6
	Avg.	86.6	8.5	1.4	85.4
Mefluidide 560 g/hectare	6-H	124.0	7.2	1.6	109.2
	7-H	157.2	6.8	1.0	84.0
	31-H	128.0	9.2	1.4	76.8
	39-H*	104.0	9.0	2.0	108.0
	48-H*	70.0	11.8	2.4	116.0
	Avg.	116.6	8.8	1.7	98.8
Mefluidide 1120 g/hectare	8-I	96.0	6.2	trace	149.2
	10-I	129.2	11.2	1.4	98.0
	16-I	70.0	14.0	2.6	118.0
	19-I	84.8	11.2	2.4	126.0
	24-I	138.0	10.4	1.8	114.8
	Avg.	103.6	10.6	1.6	121.2

* Plots in the lower field, the good growth area.

TABLE 16. Soil analysis for upper and lower part of field 'L', Kunia Substation.

Field	Plot	Depth	Zn	Mn	Cu	Fe	Avail. N
			------------------	------------------	lb/A'	------------------	------------------
Upper	36-B	0-12"	43	335	58	trace	2114
Upper	37-B	0-12"	37	230	58	trace	411
Upper	38-C	0-12"	33	240	46	trace	579
Upper	39-H	0-12"	30	215	42	trace	736
Upper	40-F	0-12"	39	270	59	trace	886
		Avg.	36	260	56	trace	945
Lower	41-X	0-12"	46	405	61	trace	1597
Lower	42-B	0-12"	29	160	55	trace	345
Lower	43-F	0-12"	35	240	63	trace	767
Lower	44-E	0-12"	39	325	60	trace	1112
Lower	45-E	0-12"	41	220	60	trace	485
		Avg.	36	270	60	trace	861

TABLE 17. -- Variation in rooting of sugarcane cultivar H62-4761 in the upper and lower parts of field 'L', Kunia Substation, Hawaiian Sugar Planters Association Experiment Station.

AREA	STOOL	DEPTH OF MOST ROOTS (CM)	DEEPEST ROOT (CM)	DEPTH TO HARD PAN	REMARKS
Upper part (40 plots)	1	32	39	23	Fewer roots beyond the depth of
	2	25	35	23	23 cm. Some roots bent, thus
	3	24	37	23	growing horizontally along the
	4	28	42	23	hard compact layer.
Mean		27.2	38.2	23	
Lower part (10 plots)	1	37	49	48	Higher density of roots, most of
	2	32	51	48	which grew straight down, with
	3	38	58	48	little or no contact with the hard
	4	33	49	48	layer.
Mean		35	51.8	48	

TABLE 18. -- Biweekly height increment (in cm) of sugarcane cultivar H62-4761 treated with different rates of ethephon, glyphosate and mefluidide.

TREATMENT RATE	7	9	11	14	15	17	19	21	23	25	28	Total
ETHEPHON:												
280 g/hectare	8.72	11.30	16.08	33.90	16.80	17.21	21.08	14.97	8.10	16.25	6.16	170.57
560 g/hectare	9.34	11.60	13.90	24.63	14.61	11.61	19.78	12.09	9.80	8.91	15.18	151.45
1120 g/hectare	10.53	14.01	13.92	27.18	14.12	18.93	18.21	11.08	9.00	12.88	11.65	161.51
GLYPHOSATE:												
67.2 g/hectare	6.50	12.50	16.70	29.38	15.64	21.41	14.41	16.47	11.25	16.37	9.67	170.30
134.4 g/hectare	3.31	8.22	11.06	22.85	15.50	17.08	23.84	15.06	12.14	14.47	12.25	155.78
224 g/hectare	2.78	4.79	7.68	19.00	11.12	33.81	9.06	17.49	13.26	11.20	14.84	145.03
MEFLUIDIDE:												
280 g/hectare	7.95	13.35	18.57	31.30	15.37	20.78	15.38	14.72	6.94	18.18	10.43	172.97
560 g/hectare	4.79	11.35	15.62	27.88	13.01	24.30	18.63	13.83	11.01	12.71	16.49	169.62
1120 g/hectare	5.02	3.06	8.91	13.39	10.85	39.01	17.79	14.07	12.03	14.19	13.75	152.07
Control	7.90	11.26	17.21	37.08	6.57	19.96	16.50	14.02	9.54	16.13	8.76	164.93

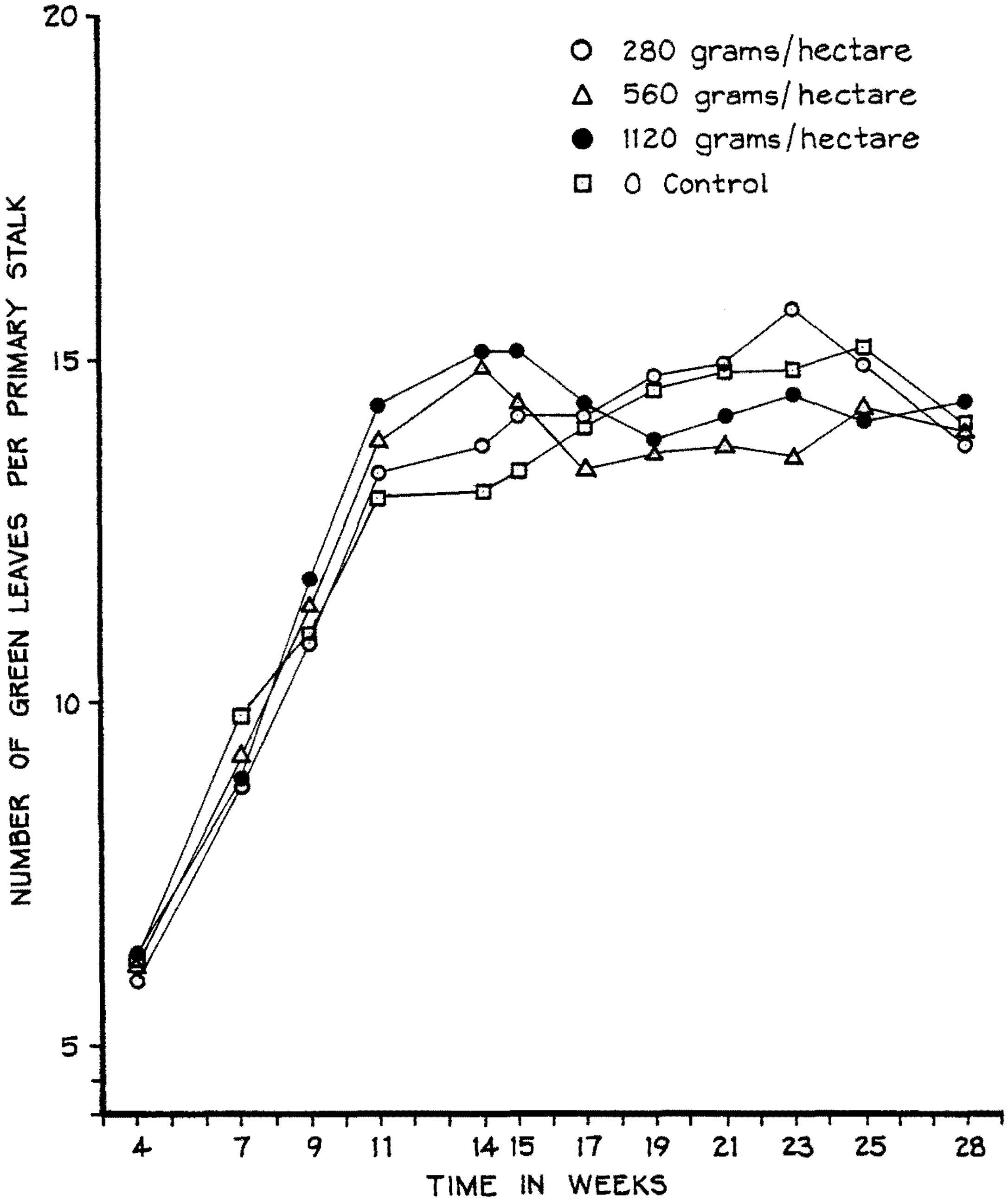

Fig. 7 Effect of Ethephon on No. Green Leaves/Stalk of Sugarcane Cultivar H62-4671

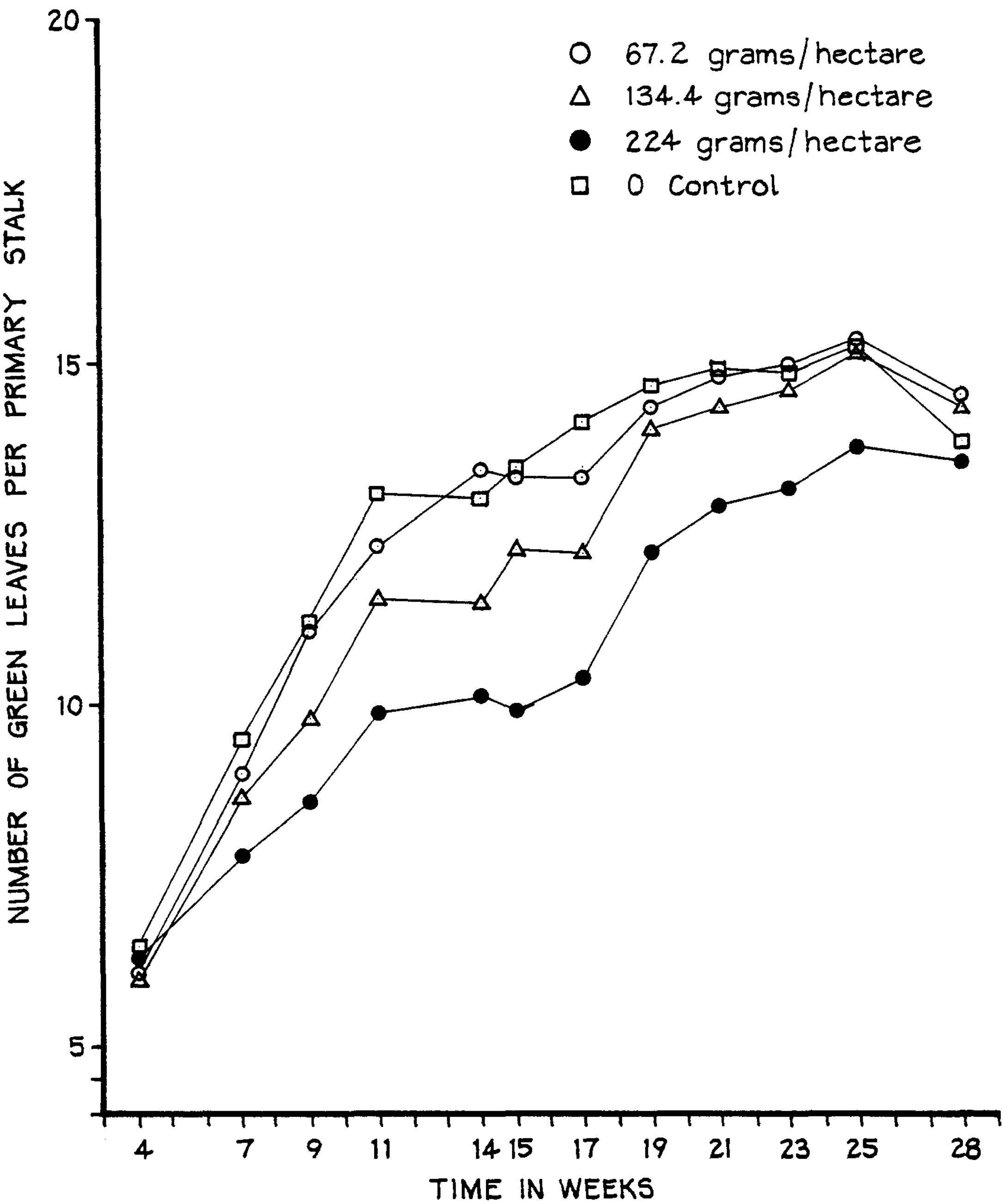

Fig. 8 Effect of Glyphosate on Number of Green Leaves/ Stalk of Sugarcane Cultivar H62-4671

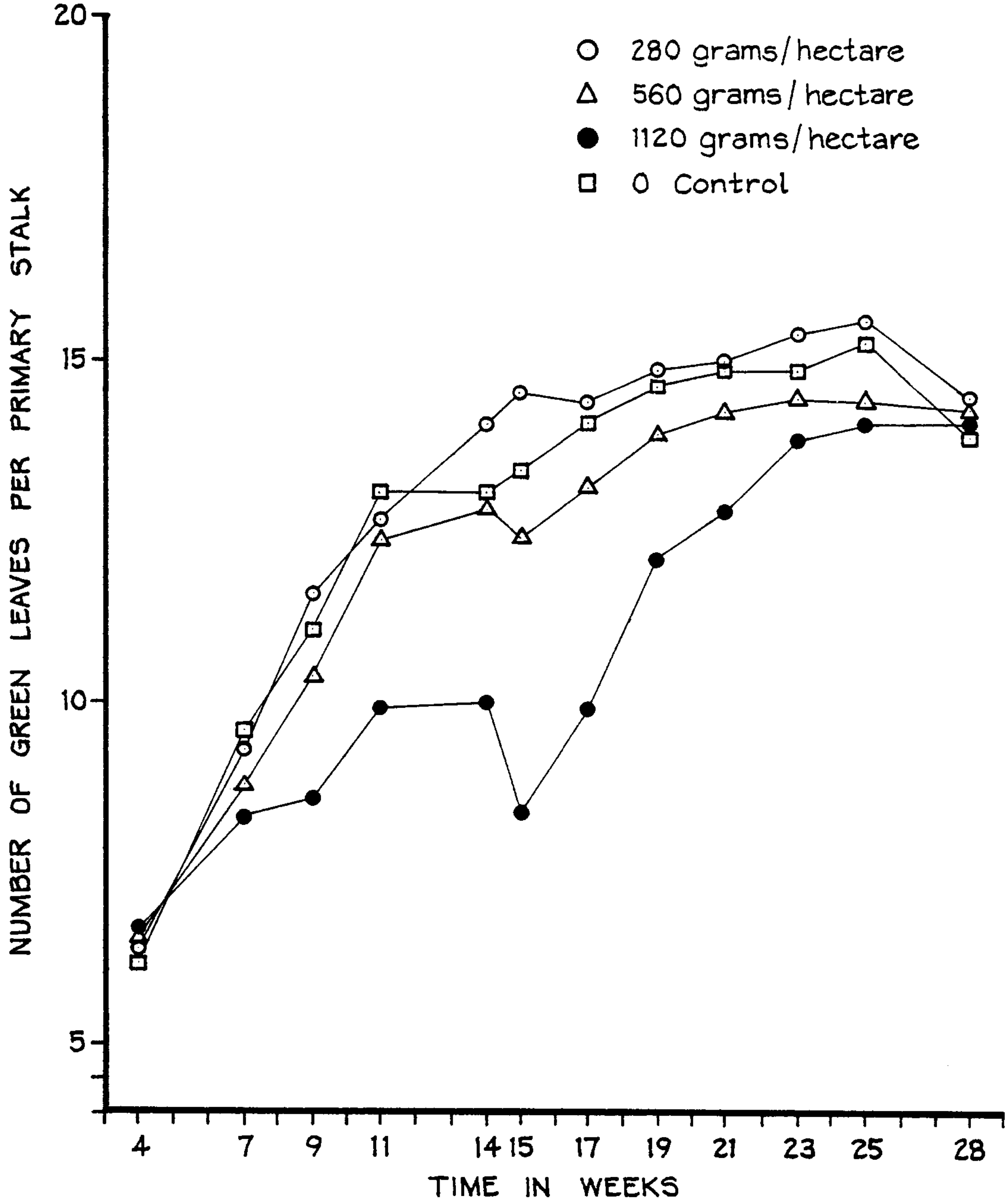

Fig. 9 Effect of Mefluidide on Number of Green Leaves/ Stalk of Sugarcane Cultivar H62-4671

TABLE 19. -- Percent light transmission to the soil through the canopy of sugarcane cultivar H62-4671 taken between 10:30 am and 1:00 pm November 15, 1979, Kunia Substation, Oahu, Hawaii.

Treatment Rate	I	II	III	IV	V	Mean
ETHEPHON:						
280 g/hectare	20.31	20.83	31.90	35.71	24.41	26.63
560 g/hectare	28.28	19.05	33.86	39.15	53.97	34.86
1120 g/hectare	26.67	36.62	42.86	38.03	21.35	33.11
GLYPHOSATE:						
67.2 g/hectare	25.00	46.15	43.33	38.02	30.48	36.60
134.4 g/hectare	32.80	39.05	38.89	22.22	17.46	30.08
224 g/hectare	32.28	47.47	23.81	44.44	50.26	39.65
MEFLUIDIDE:						
280 g/hectare	30.52	34.29	31.46	26.04	42.42	32.95
560 g/hectare	35.71	43.39	23.44	39.49	32.31	34.87
1120 g/hectare	38.97	34.38	43.08	25.71	44.79	37.39
Control	19.05	37.04	28.65	34.92	37.14	31.36

TABLE 20. -- Subjective grading of plots of sugarcane cultivar H62-4671 at 21 weeks of growth. Scale 1-9 (The higher the number the poorer the Grade).

	REPLICATION					
TREATMENT RATE	I	II	III	IV	V	AVERAGE
ETHEPHON						
280 g/hectare	4.0	3.0	4.0	2.0	3.0	3.20
560 g/hectare	6.0	3.0	5.0	5.0	3.0	4.40
1120 g/hectare	5.0	5.0	5.0	5.0	2.0	4.40
GLYPHOSATE						
67.2 g/hectare	0.0	3.0	4.0	5.0	5.0	4.25
134.4 g/hectare	5.0	5.0	5.0	6.0	4.0	4.40
224 g/hectare	6.0	6.0	4.0	4.0	4.0	4.80
MEFLUIDIDE						
280 g/hectare	4.0	5.0	5.0	5.0	2.0	4.20
560 g/hectare	4.0	5.0	5.0	5.0	3.0	4.40
1120 g/hectare	6.0	5.0	6.0	5.0	5.0	5.40
Control	2.0	4.0	4.0	4.0	3.0	4.00

TABLE 21. -- Sugar analysis for sugarcane cultivar H62-4671; Experiment 79T-1, Kunia Substation, Oahu, Hawaii, January 21-23, 1980.

	JUICE			CANE		
TREATMENT RATE	RF*SOL	POL	PURITY	FPC**	RSPC#	PPC+
ETHEPHON						
280 g/hectare	9.37	6.90	73.47	9.21	8.51	6.26
560 g/hectare	10.33	8.00	77.14	9.78	9.31	7.21
1120 g/hectare	9.98	7.50	75.03	9.84	9.00	6.76
Control	10.88	8.54	77.96	9.91	9.79	7.68
GLYPHOSATE						
67.2 g/hectare	10.51	8.09	76.66	10.07	9.44	7.27
1334.4 g/hectare	10.01	7.59	75.69	9.70	9.04	6.85
224 g/hectare	9.80	7.18	73.23	9.51	8.86	6.49
Control	10.88	8.54	77.96	9.91	9.79	7.68
MEFLUIDIDE						
280 g/hectare	9.33	6.87	73.47	9.34	8.46	6.23
560 g/hectare	9.96	7.63	76.05	9.47	9.00	6.90
1120 g/hectare	9.88	7.32	74.04	9.62	8.93	6.61
Control	10.88	8.54	77.96	9.91	9.79	7.68

* Refractometer solids

** Fiber percent cane

\# Refractometer solids percent cane

\+ Pol percent cane

TABLE 22. -- Length of Leaf with a First Visible Dewlap (in cm) of Sugarcane Cultivar H62-4671, Experiment 79T-1, Kunia Substation Field L.

TREATMENT RATE	DATE	WKS OF GROWTH	REPLICATION I	II	III	IV	V	AVG.
ETHEPHON:	8:3:79	4						
280 g/hectare			64.90	66.18	57.63	51.03	49.85	52.84
560 g/hectare			47.00	60.81	56.01	53.75	52.25	52.25
1120 g/hectare			55.81	58.84	57.35	59.42	59.82	57.86
GLYPHOSATE:								
67.2 g/hectare			67.97	59.65	53.16	63.95	47.13	48.37
134.4 g/hectare			57.17	55.99	49.99	49.75	58.91	55.33
224 g/hectare			55.38	50.80	62.93	57.32	49.07	54.14
MEFLUIDIDE:								
280 g/hectare			63.23	60.38	59.47	65.88	55.89	59.74
560 g/hectare			56.05	54.01	69.63	52.20	55.55	54.45
1120 g/hectare			52.70	59.00	57.10	60.16	59.27	57.65
Control			57.20	51.48	57.28	56.79	58.04	55.90
ETHEPHON:	8:23:79	7						
280 g/hectare			92.26	93.70	87.10	82.20	71.77	80.36
560 g/hectare			68.78	81.24	81.30	76.65	74.25	75.25
1120 g/hectare			80.86	73.65	70.70	70.61	79.38	73.96
GLYPHOSATE:								
67.2 g/hectare			83.47	91.29	88.08	89.23	77.12	85.84
134.4 g/hectare			66.21	79.22	69.88	84.34	86.50	71.64
224 g/hectare			62.00	66.59	74.59	69.25	61.08	64.73
MEFLUIDIDE:								
280 g/hectare			87.30	89.45	86.65	103.93	85.57	87.24
560 g/hectare			81.40	76.15	84.70	81.15	80.01	79.68
1120 g/hectare			64.46	70.85	74.55	67.92	77.64	71.08
Control			98.48	97.00	91.14	93.33	99.33	95.15
ETHEPHON:	9:6:79	9						
280 g/hectare			99.30	111.01	94.49	103.50	96.38	98.12
560 g/hectare			81.45	96.43	81.45	86.90	81.90	82.93
1120 g/hectare			79.63	72.38	69.30	76.82	84.22	74.53
GLYPHOSATE:								
67.2 g/hectare			98.46	116.50	111.58	106.47	110.69	108.72
134.4 g/hectare			66.70	95.07	85.87	110.40	110.08	82.55
224 g/gectare			63.60	66.41	78.92	67.07	63.88	65.25

TABLE 22.--(Continued) Length of Leaf with a First Visible Dewlap (in cm) of Sugarcane Cultivar H62-4671, Experiment 79T-1, Kunia Substation Field L.

TREATMENT RATE	DATE	WKS OF GROWTH	REPLICATION I	II	111	IV	V	AVG.
MEFLUIDIDE:	9:6:79	9						
280 g/hectare			110.83	116.28	105.02	119.82	121.14	113.32
560 g/hectare			81.77	82.20	81.48	99.32	97.89	90.30
1120 g/hectare			52.90	59.38	50.48	49.77	64.32	55.37
Control			118.40	119.92	121.02	119.07	122.63	120.66
ETHEPHON:	9:20:79	11						
280 g/hectare			111.12	112.22	111.50	119.82	105.68	112.33
560 g/hectare			98.05	108.70	99.45	101.33	100.09	99.73
1120/g/hectare			97.00	92.40	94.42	96.58	101.00	95.10
GLYPHOSATE:								
67.2 g/hectare			117.65	128.69	121.48	121.77	117.28	121.37
134.4 g/hectare			85.92	110.75	97.35	120.70	122.80	98.01
224 g/hectare			57.46	74.45	90.33	88.35	65.10	71.34
MEFLUIDIDE:								
280 g/hectare			123.48	128.60	118.35	114.45	130.61	125.26
560 g/hectare			98.30	90.51	111.60	125.37	119.40	108.40
1120 g/hectare			69.93	62.35	70.76	72.18	63.30	67.70
Control			118.00	130.55	130.88	132.10	122.03	128.89
ETHEPHON	10:9:79	14						
280 g/hectare			117.73	123.51	124.70	122.95	129.67	125.77
560 g/hectare			121.20	126.70	115.00	119.80	123.10	119.78
1120 g/hectare			123.70	123.50	118.60	123.55	126.97	122.34
GLYPHOSATE:								
67.2 g/hectare			127.25	127.65	121.00	124.10	125.55	125.11
134.4 g/hectare			101.30	112.40	111.25	117.70	119.27	108.32
224 g/hectare			82.70	95.55	107.55	111.00	84.95	93.55
MEFLUIDIDE:								
280 g/hectare			128.45	127.35	126.25	115.26	128.15	128.15
560 g/hectare			122.90	107.60	123.53	126.85	126.25	120.90
1120 g/hectare			81.75	100.30	106.05	90.30	97.85	85.25
Control			116.50	130.30	125.35	124.80	115.30	123.94
ETHEPHON:	10:18:79	15						
280 g/hectare			122.61	123.85	129.90	126.65	133.53	130.03
560 g/hectare			140.05	127.20	129.05	126.50	131.35	131.71
1120 g/hectare			133.90	131.65	130.35	130.35	130.25	131.56

TABLE 22. -- (Continued) Length of Leaf with a First Visible Dewlap (in cm) of Sugarcane Cultivar H62-4671, Experiment 79T-1, Kunia Substation Field L.

TREATMENT RATE	DATE	WKS OF GROWTH	I	II	III	IV	V	AVG.
GLYPHOSATE:	10:18:79	15						
67.2 g/hectare			133.60	134.25	126.05	124.90	133.15	130.39
134.4 g/hectare			112.60	121.55	121.95	116.30	119.95	118.70
224 g/hectare			89.25	105.50	117.26	123.20	99.70	104.41
MEFLUIDIDE:								
280 g/hectare			128.90	132.45	134.15	113.35	130.25	131.44
560 g/hectare			126.45	107.05	124.32	129.20	129.40	123.03
1120 g/hectare			101.50	103.55	112.10	98.80	105.60	104.31
Control			121.15	134.90	129.45	131.20	114.95	127.63
ETHEPHON:	11:1:79	17						
280 g/hectare			120.20	127.04	130.50	123.21	130.11	127.94
560 g/hectare			138.05	130.43	130.25	124.13	127.34	129.94
1120 g/hectare			137.20	135.60	129.12	129.97	128.82	132.97
GLYPHOSATE:								
67.2 g/hectare			133.30	132.00	122.07	134.44	125.60	129.48
134.4 g/hectare			117.05	128.72	119.92	107.70	122.23	121.90
224 g/hectare			129.02	127.22	135.87	136.56	126.14	129.74
MEFLUIDIDE:								
280 g/hectare			129.66	127.67	129.15	114.72	131.50	130.00
560 g/hectare			130.94	120.42	121.69	131.30	128.50	127.79
1120 g/hectare			132.88	133.50	115.25	127.20	126.14	126.99
Control			122.24	128.50	129.10	129.95	116.13	125.92
ETHEPHON:	11:15:79	19						
280 g/hectare			127.83	124.95	137.10	131.01	130.44	132.85
560 g/hectare			136.13	134.87	137.60	122.95	129.97	131.66
1120 g/hectare			139.61	140.03	137.14	133.72	126.26	137.63
GLYPHOSATE:								
67.2 g/hectare			133.02	137.15	134.32	138.43	127.11	133.99
134.4 g/hectare			142.25	131.88	133.21	101.99	125.43	135.78
224 g/hectare			127.21	127.13	141.08	139.48	121.00	128.71
MEFLUIDIDE:								
280 g/hectare			134.09	140.41	136.73	115.41	132.07	135.83
560 g/hectare			135.78	127.54	126.82	137.70	138.00	134.76
1120 g/hectare			137.93	139.36	143.50	151.80	134.57	141.43
Control			120.37	135.35	134.33	134.20	122.07	131.49

TABLE 22. - (Continued) Length of Leaf with a First Visible Dewlap (in cm) of Sugarcane Cultivar H62-4671, Experiment 79T-1, Kunia Substation Field L.

			REPLICATION					
TREATMENT RATE	DATE	WKS OF GROWTH	I	II	III	IV	V	AVG.
ETHEPHON:	11:29:79	21						
280 g/hectare			128.89	120.29	134.62	125.11	130.84	130.19
560 g/hectare			134.35	136.17	134.45	124.75	121.68	128.81
1120 g/hectare			133.92	134.75	132.95	133.35	121.88	133.74
GLYPHOSATE:								
67.2 g/hectare			135.28	232.90	135.87	134.56	129.05	133.53
134.4 g/hectare			137.44	134.00	132.83	112.99	125.38	134.76
224 g/hectare			136.57	133.72	139.88	140.11	139.64	137.51
MEFLUIDIDE:								
280 g/hectare			129.70	134.29	129.29	114.08	134.75	132.01
560 g/hectare			135.63	125.84	128.18	134.20	134.40	132.52
1120 g/hectare			133.50	137.17	139.14	126.50	138.58	134.98
Control			127.86	135.90	136.90	135.20	122.15	132.54
ETHEPHON:	12:13:79	23						
280 g/hectare			127.66	134.95	135.20	125.57	134.21	131.66
560 g/hectare			128.05	130.86	131.70	125.11	121.96	126.71
1120 g/hectare			134.75	131.48	129.32	127.82	128.28	133.34
GLYPHOSATE:								
67.2 g/hectare			137.80	133.00	136.30	133.33	130.80	134.25
134.4 g/hectare			137.44	135.94	132.50	120.36	130.71	135.29
224 g/hectare			135.79	136.50	134.29	140.39	133.29	136.49
MEFLUIDIDE:								
280 g/hectare			134.79	135.96	132.31	123.96	136.55	134.90
560 g/hectare			135.29	123.08	131.97	134.35	136.65	132.34
1120 g/hectare			135.25	137.19	137.43	134.10	137.58	135.71
Control			126.51	133.50	135.15	135.65	126.41	132.68
ETHEPHON:	12:27:79	25						
280 g/hectare			140.90	132.50	137.30	127.91	136.22	133.81
560 g/hectare			138.55	133.70	132.35	131.10	117.90	129.98
1120 g/hectare			138.35	137.20	133.30	133.35	139.50	135.55
GLYPHOSATE:								
67.2 g/hectare			139.20	136.35	134.17	138.11	137.50	137.06
134.4 g/hectare			138.94	137.72	133.61	139.60	132.40	136.76
224 g/hectare			136.14	143.17	146.56	138.94	136.79	138.76

TABLE 22. --(Continued) Length of Leaf with First Visible Dewlap (in cm) of Sugarcane Cultivar H62-4571, Experiment 79T-1, Kunia Substation Field L.

TREATMENT RATE	DATE	WKS OF GROWTH	REPLICATION I	II	III	IV	V	AVG.
MEFLUIDIDE:								
280 g/hectare			137.30	132.40	131.56	135.00	134.05	133.83
560 g/hectare			134.70	126.63	136.90	137.75	140.20	134.82
1120 g/hectare			138.63	134.63	139.14	139.70	138.58	138.14
Control			130.70	136.20	138.10	137.80	135.97	137.02
ETHEPHON:	1:17:80	28						
280 g/hectare			124.00	127.56	126.40	120.20	126.23	124.28
560 g/hectare			126.50	131.90	119.10	122.22	112.56	120.10
1120 g/hectare			127.25	127.60	122.60	126.56	127.00	126.00
GLYPHOSATE:								
67.2 g/hectare			124.35	126.35	122.50	124.61	215.66	124.69
134.4 g/hectare			125.94	127.39	128.44	216.33	216.89	127.26
224 g/hectare			115.29	128.78	125.78	128.67	122.64	123.85
MEFLUIDIDE:								
280 g/hectare			125.60	125.10	122.45	128.30	126.50	124.91
560 g/hectare			125.00	120.14	125.22	124.75	123.60	123.37
1120 g/hectare			125.75	129.50	123.36	129.40	123.67	126.34
Control			128.17	123.25	126.65	124.95	124.10	124.74

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