EFFECT OF METHOD OF SEED BED PREPARATION, MULCHING AND TIME OF PLANTING ON YAM IN WESTERN NIGERIA

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SUMMARY

Mulching of yam seed beds reduced soil temperature and improved emergence, time of emergence, yield per hill and the total yield of *Dioscorea rotundata* yams on a sandy soil in Western Nigeria. Comparison of mounds with ridged and flat seed beds showed that these different treatments had no significant effect on tuber yield. Planting about six weeks before the onset of the rains and the use of mulch is indicated as a good technique to obtain high yield.

RESUME

L'utilisation de paillis dans les lits de plantation réduit la température du sol et favorise la levée, le temps d'émergence, le rendement par poquet et le rendement global des ignames *Dioscorea rotundata* lorsqu'elles sont cultivées en sol sablonneux à l'Quest du Nigéria. Lorsque la comparaison a été faite entre la culture en buttes et en lits de semis non élevés, les résultats ont montré que la différence de rendement en tubercules est peu sensible, qu'il s'agisse de 1'une ou de 1'autre méthode. La plantation six semaines avant le début des pluies et l'utilisation de paillis permettent d'obtenir un rendement élevé.

RESUMEN

El cubrimiento de almacigos de ñame redujo la temperatura del suelo y mejoró la emergencia, el tiempo de emergencia rendimiento por cepa y rendimiento total de ñame, *Dioscorea rotundata*, en un suelo arenoso de Nigeria Occidental. La comparación de camas con almacigos alomados o planos demostró que no hay diferencia entre ninguno de estos tratamientos en cuanto al rendimento de tubérculos. La siembra, cerca de 6 semanas antes del establecimiento de las lluvias y el uso de cobertura, se indica como una buena técnica para obtener altos rendimientos.

INTRODUCTION

Yam cultivation in West Africa extends from the central Ivory Coast to the Cameroon mountains, in both the forest zone and the southern parts of the savannah[1,9]. Annual production in West Africa is about 31 million metric tons, or two-thirds of the total world production.

Yams require about 8 months from planting to maturity, and need, depending on soil conditions, 1500 to 1800 mm of rain during the growing period[6]. They have a shallow root system. In Western Nigeria, where the dry season occurs from November until March, 'early planting' is generally done during the period from November to February. It has been shown that yams planted from November to January give 30 percent higher yield than those planted at the onset of rains[13].

Yams are often planted on mounds. The size of the mounds depend primarily on soil depth and the depth of the water table[13]. On sandy soils however planting is generally on flat beds[11]. Planting of yams in trenches has been shown to be of advantage for shallow and stony soils[8,14]. Experiments conducted at Wenchi and Ejura in Ghana showed that yams grown on ridges yielded more than those grown on mounds[10]. In Puerto Rico planting on raised beds increased the yield.

Farmers of West Africa traditionally place a 'cap' of dried straw on the mounds over newly planted setts[12]. Previous experiments in Ghana showed a favourable effect of mulching on yam production particularly in the savannah zone[2,4]. In Nigeria, mulching improved emergence by 50 percent and the overall yield by 3.75 tons per hectare. Mulching immediately after planting as compared with mulching at a later date was advantageous. Soil temperature measurements taken at 2 p.m. showed temperatures of 37.5 and 40° C. respectively for mulched and unmulched plots[13]. Mulching has been proved beneficial for both late and early yam plantings.[5].

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MATERIALS AND METHODS

A factorial experiment, involving three methods of seed bed preparation, two levels of mulching and three times of planting, was conducted at the International Institute of Tropical Agriculture (IITA). IITA is located about 30 km south of the northern limit of the lowland rain forest. Rainfall distribution is bimodal in Western Nigeria, with rains from April to July and from August to November. The experiment was conducted during 1971-72 on soil of Egbeda association derived from basement complex rocks. The soil has a sandy surface and a layer of angular and sub-angular quartz gravels in the horizon immediately below the surface horizon and below this a deep, red clay profile.

Three different kinds of seed beds, 10 x 2 m, were prepared from a disced field as follows: (1) flat, natural level surface, (2) mounds or hillocks 50 cm high and about 150 cm in the base circumference formed by scraping up the surface soil, and (3) ridges, about 30 cm high made across the slope at a spacing of 75 cm.

Mulching with rice straw at a rate of 4 tons per hectare was compared with no mulching. There were two planting dates before the onset of the rains (October 30, 1971 and February 1, 1972) and one at the start of the rainy season (April 15, 1972).

Two setts of the local cultivar 'Fele' of approximately 50 g weight were planted 10 cm below the soil surface at each mound. For flat and ridged seed beds single setts were planted at 50 cm intervals within the row. Twenty setts were planted in each plot. The experimental design was a randomized block with four replications.

Soil temperature was measured at 5 and 20 cm depth at 7.30 a.m. and 2.30 p.m. in one replication for each treatment. The emergence count and the time of emergence were recorded for all plots individual treatments. Staking of the vines was done one week after emergence. Yams planted on October 30, 1971 were harvested on September 30, 1972 and the two later plantings were harvested on November 1, 1972. Tuber weight and number of tubers per plant and the total yield per plot were determined for each plot.

RESULTS AND DISCUSSION

A. Soil temperature

Methods of seed bed preparation and mulching had a clear effect on soil temperature (Figures 1 and 2). The highest temperature was recorded for ridges and mounds. Ridge mulching decreased the soil temperature between 5 and 13.5°C at 2.30 p.m. for 5 cm depth at various times during the growing season. Diurnal fluctuations in soil temperature at 5— and 20— cm depth were also highest for heaps and ridges being in the order of 15 to 18°C. Mulching on flat beds not only gave the lowest maximum temperatures throughout the growing season but also reduced the diurnal temperature fluctuation.

B. Emergence

There was a significant effect of time of planting, mulching and methods of seed bed preparation on emergence (Fig. 3). Poor emergence for the early planting on October 30 may be due to high soil temperature and dry soil conditions. Planting on the flat seed bed with mulching gave the highest emergence for the early planting. Emergence on unmulched plots was extremely poor for the first planting, irrespective of the methods of seed bed preparation. Due to more favourable soil moisture and temperature, emergence for the second and third planting was higher than that of the first planting. Mulching significantly improved yam emergence, not only for all the methods of seed bed preparation, but also for all planting dates. With flat planting, for instance, mulching improved emergence by 73.5, 78.0 and 36.5 percent for the first, second and third planting respectively. Planting on the unmulched heaps and ridges for early planting was a total failure.

Time of emergence was also significantly affected by methods of seed bed preparation and mulching (Table 1). Emergence, in general, was the quickest for plantings on the flat. Early planting gave the slowest emergence (due to the high soil temperature and drought) (Fig. 4). Mulching reduced the time to emergence for all the methods of seed bed preparation and dates of plantings (Table 1, Figs. 5, 6).

C. Yield and yield parameters

Tuber size:

Time of planting and mulching had a significant effect on tuber size (Fig. 7). The longer the growing period, the larger the tuber size. Methods of seed bed preparation under these experimental conditions did not have a significant effect on tuber size, though planting on flat generally produced smaller tubers compared to plantings on ridge or mound. Mulching significantly affected tuber size for all the three plantings, and hence soil temperature seems to play the dominant role in determining the tuber size.

Figure 1. *Effect of Mulching and Seed Bed preparation on soil temperature at 5 cm depth.*

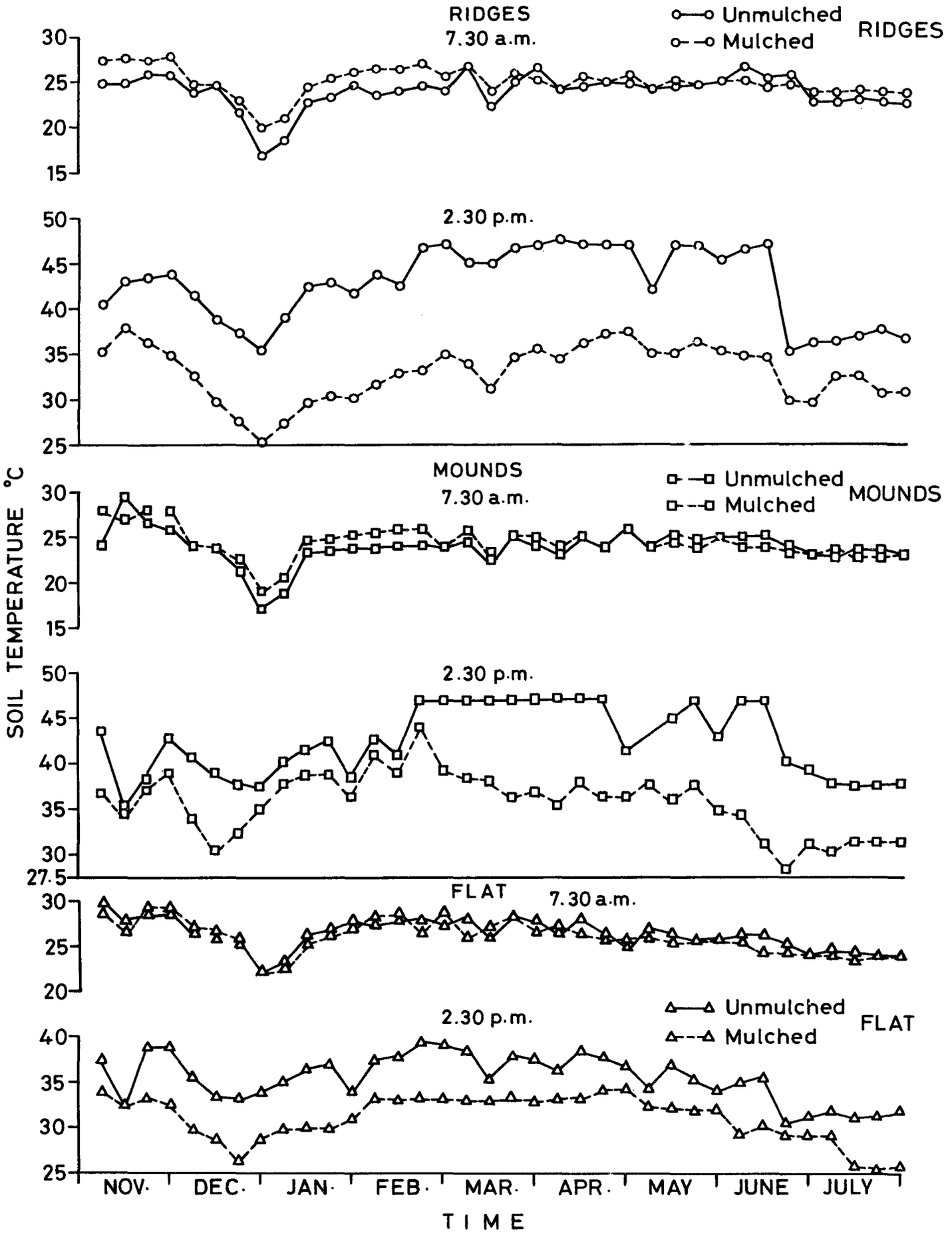
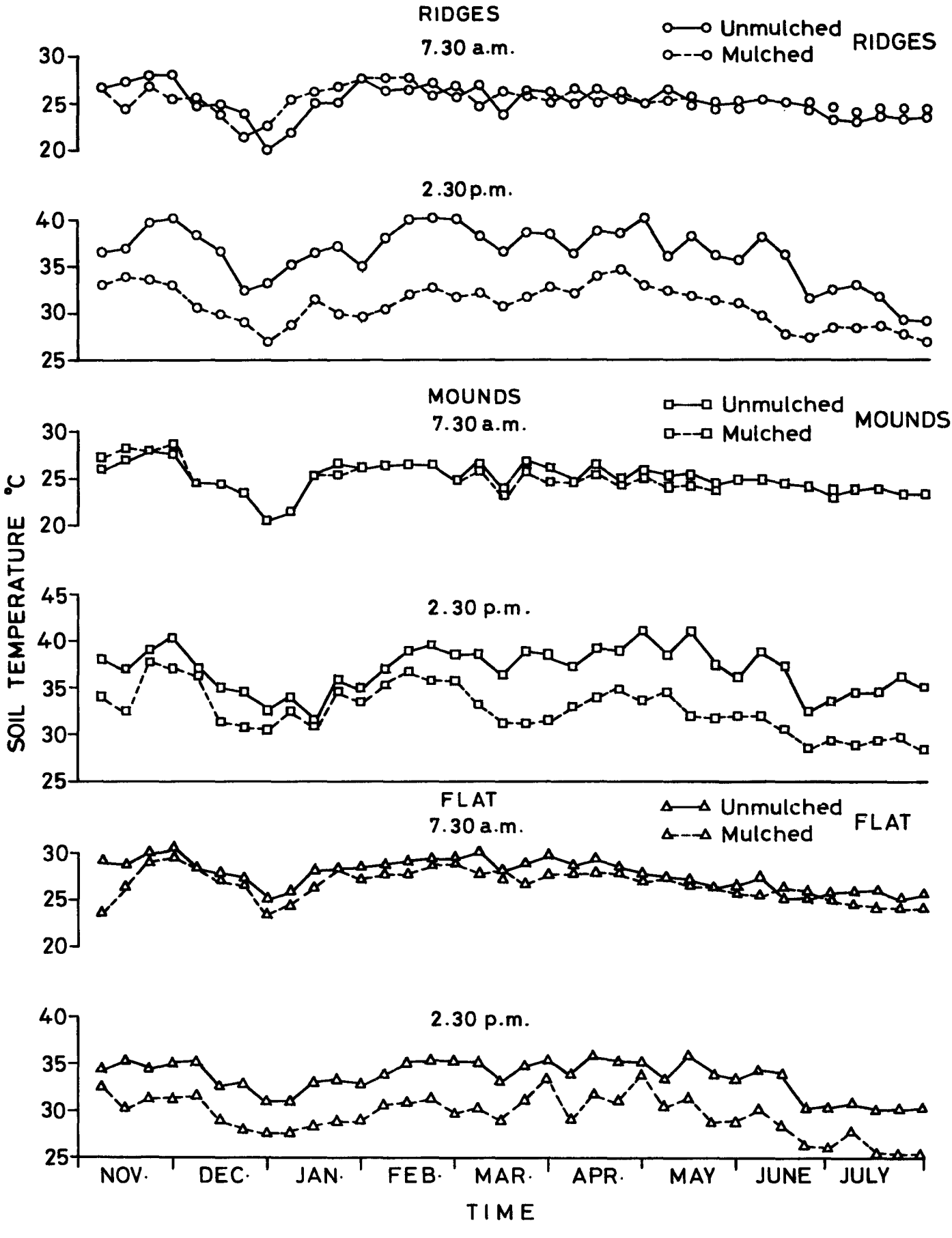


Figure 2. *Effect of Mulching and Seed Bed preparation on soil temperature at 20 cm depth.*



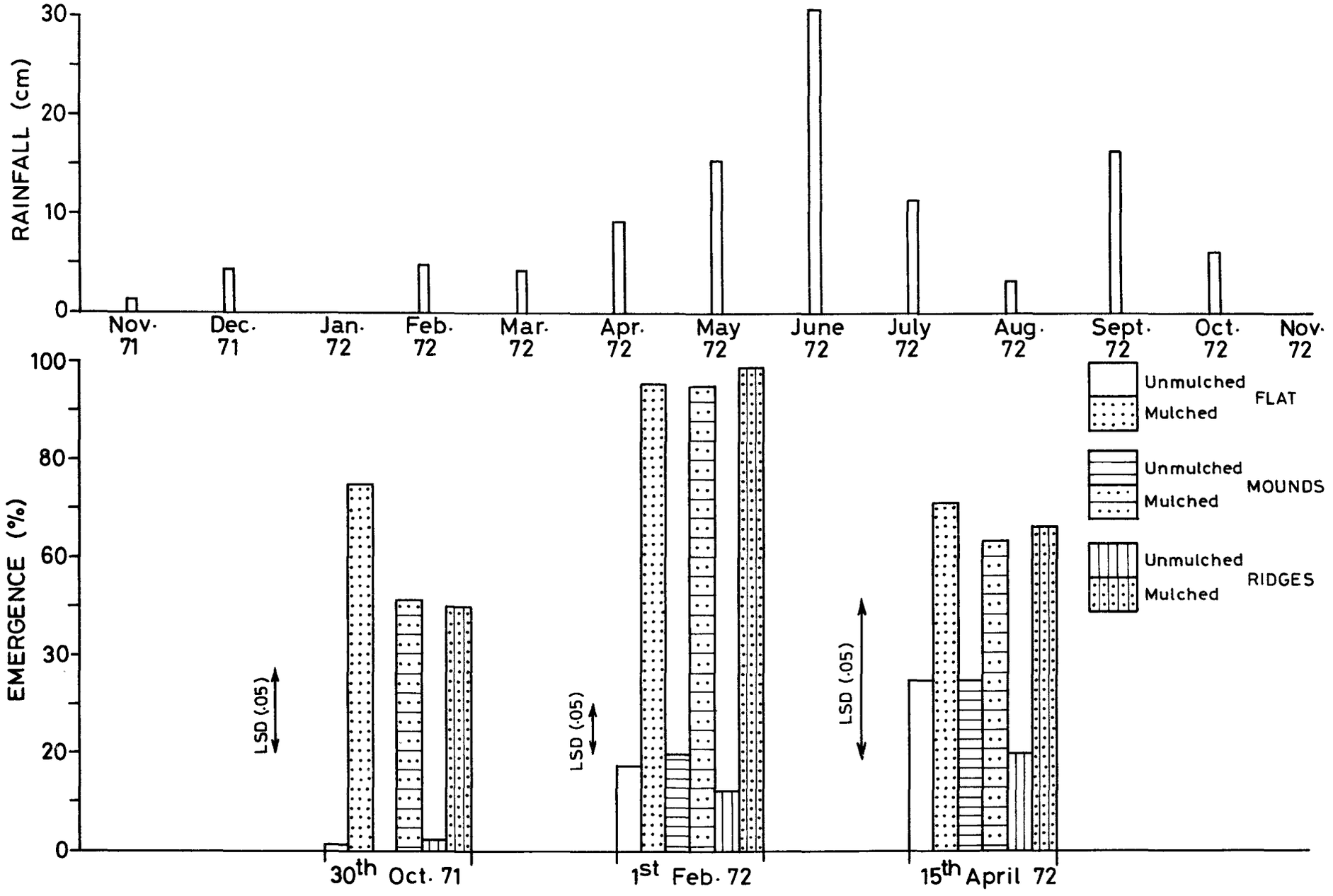


Figure 3. *Effect of time of planting, mulching and seed bed preparation on emergence.*

Yield per hill:

Yield per hill was also the highest for the early planting and mulching significantly improved the yield per hill for all three plantings (Fig. 8) There was an eight-fold increase in yield by mulching on flat for the early plantings as compared to a total failure for unmulched heaps and ridges. Statistical analyses of the data for the number of tubers per hill also indicated a significantly favourable effect of mulching.

Total yield per plot:

The highest yield was obtained for the February and the lowest for the April planting (Fig. 9). The yield for the flat mulched plots was equivalent to 31.6, 41.6 and 8.4 tons per hectare for the plantings on October 30, February 1 and April 15 respectively. While there was no yield for the unmulched heaps and ridges for October planting, favourable soil temperature and moisture regime produced some yield, though small, for the two later unmulched plantings.

Mulching had a highly significant effect on total yield, irrespective of methods of seed bed preparation and time of planting (Table 2). Methods of seed bed preparation *per se* had no effect on total yield.

REFERENCES

1. Agboola, S.A. (1968) The traditional significance of yam in Yorubaland in pre-colonial times. *Niger. Agric. J.* 5, 59-62.
2. Anon. (1954) Report of the Ministry of Agriculture, Ghana, 1953-54.
3. Anon. (1955) Report of the Ministry of Agriculture, Ghana, 1954-55.
4. Baker, E.F. (1962) Rep. Crop Husb. Res. Sect. Minist. Agric. Nat. Resourc. W. Nigeria 1961-2.
5. Campbell, J.S. *et al.* (1962) Recent developments in the production of food crops in Trinidad. *Trop. Agr. Trin.* 39, 261-70
6. Costas, R.C., *et al.* (1968) Effect of various cultural practices in yields of yams in Puerto Rico. *J. Agric. Univ. P. Rico.* 52, 356-61.
7. Coursey, D.G. (1967) *Yams.* Longman, London.
8. Coursey, D.G. (1971) The history and the possible future of yam cultivation in West Africa. Seminar Root and Tuber Crops in West Africa. IITA, Ibadan, February 22-26, 1971.
9. Doku, E.V. (1970) Root crops in Ghana, *Ghana J. Sci.* 6, 15-36.
10. Morgan, W.B. (1955) Farming practice, settlement pattern and population density in southeastern Nigeria. *Geogr. J.* 121, 138-50.
11. Owusu, P.M. *et al.* (1969) Yam farming in Ghana. *Ghana Fms.* 13, 132-5.
12. Torto, J.O. (1956) The cultivation of yams in the Goldcoast. *New Goldcoast Fms.* 1, 6-8.
13. Waitt, A.W. (1960) Yam trials. Fed. Dep. Agric. Res. Nigeria 1958-9. 13-14.
14. ------ (1963) Yams, *Dioscorea* species. *Field Crop Abst.* 16, 145-57.

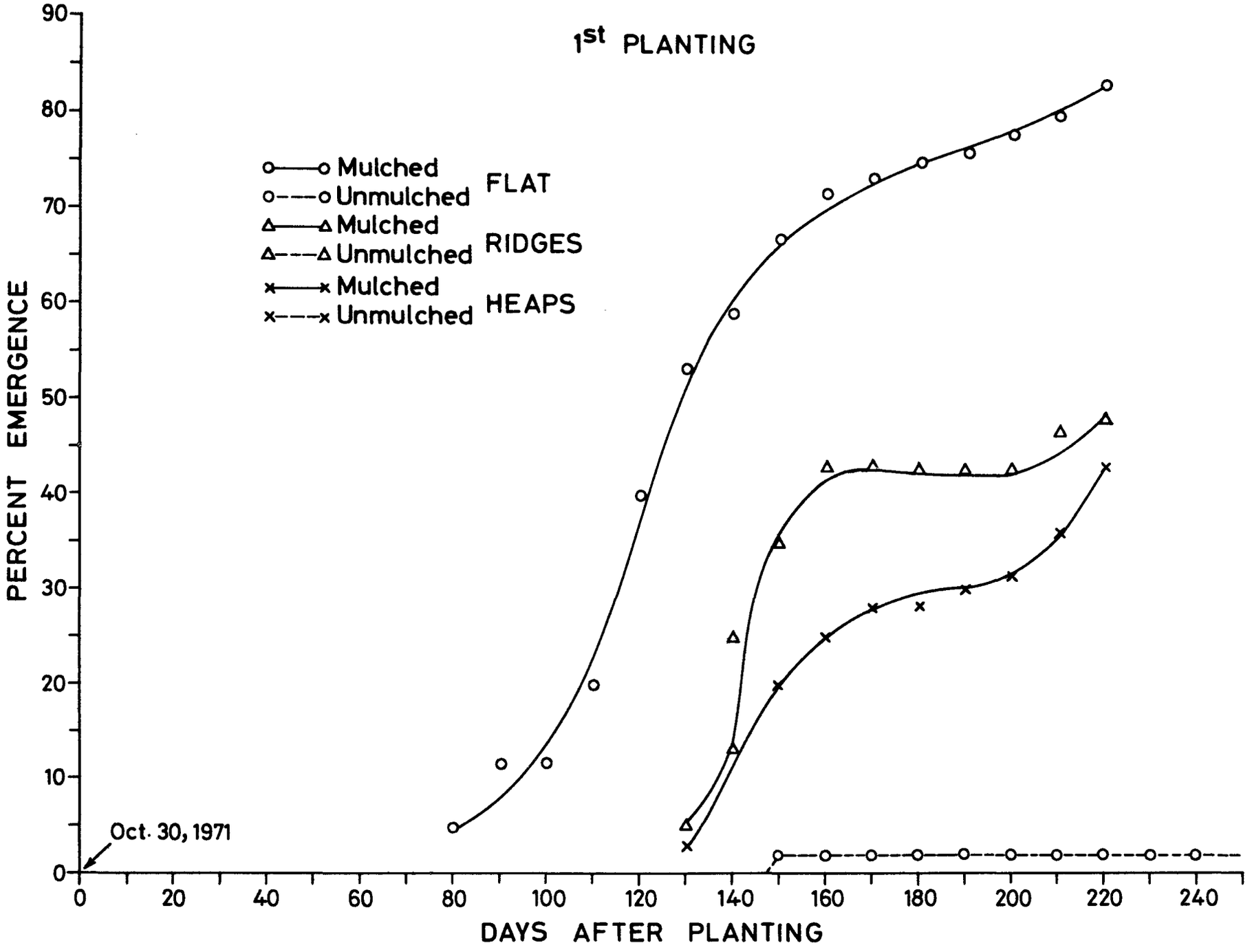


Figure 4. *Effect of seed bed preparation and mulching on rate of emergence for planting on October 30, 1971.*

Figure 5. *Effect of seed bed preparation and mulching on rate of emergence for planting on February 1, 1972.*

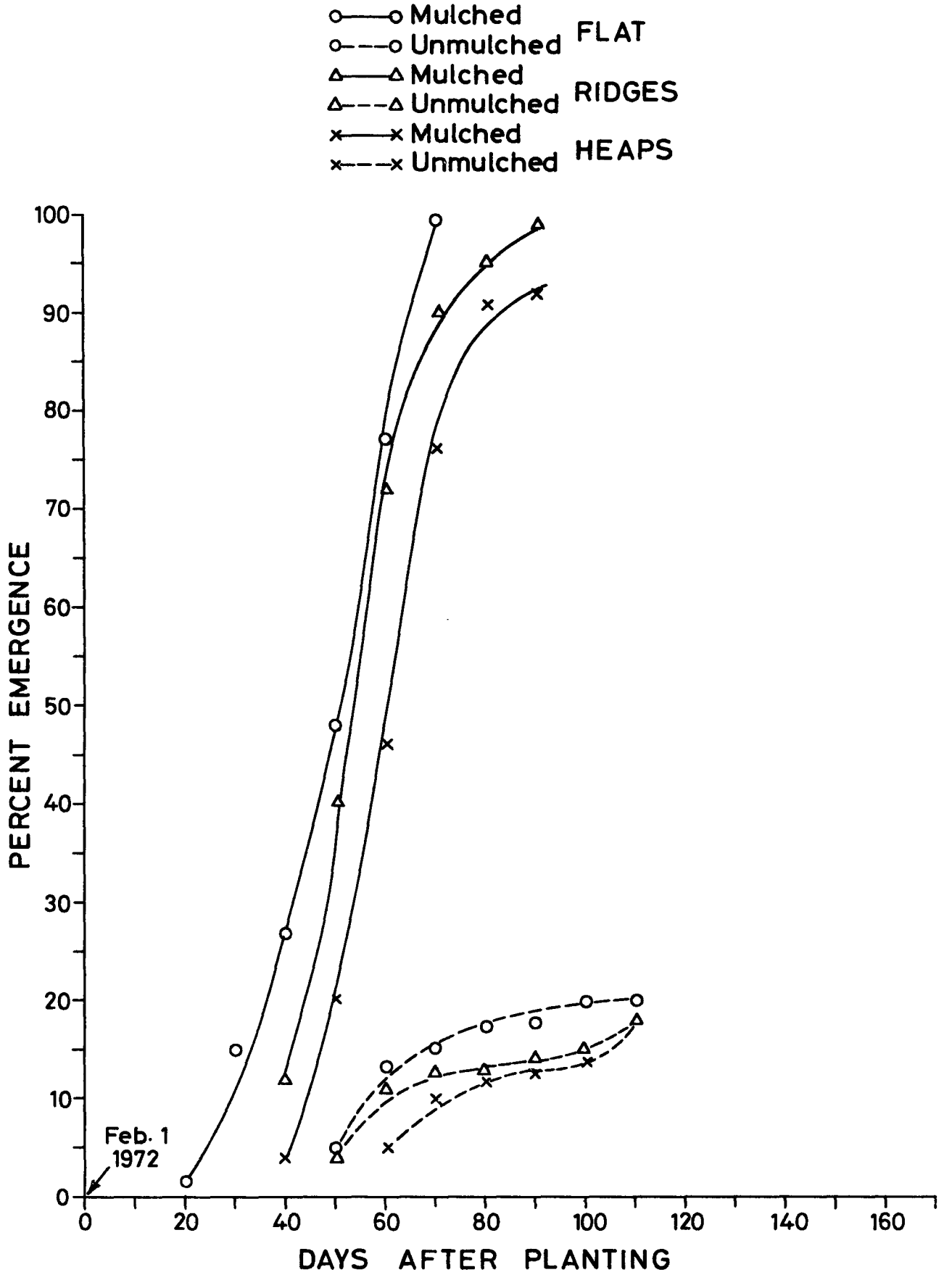
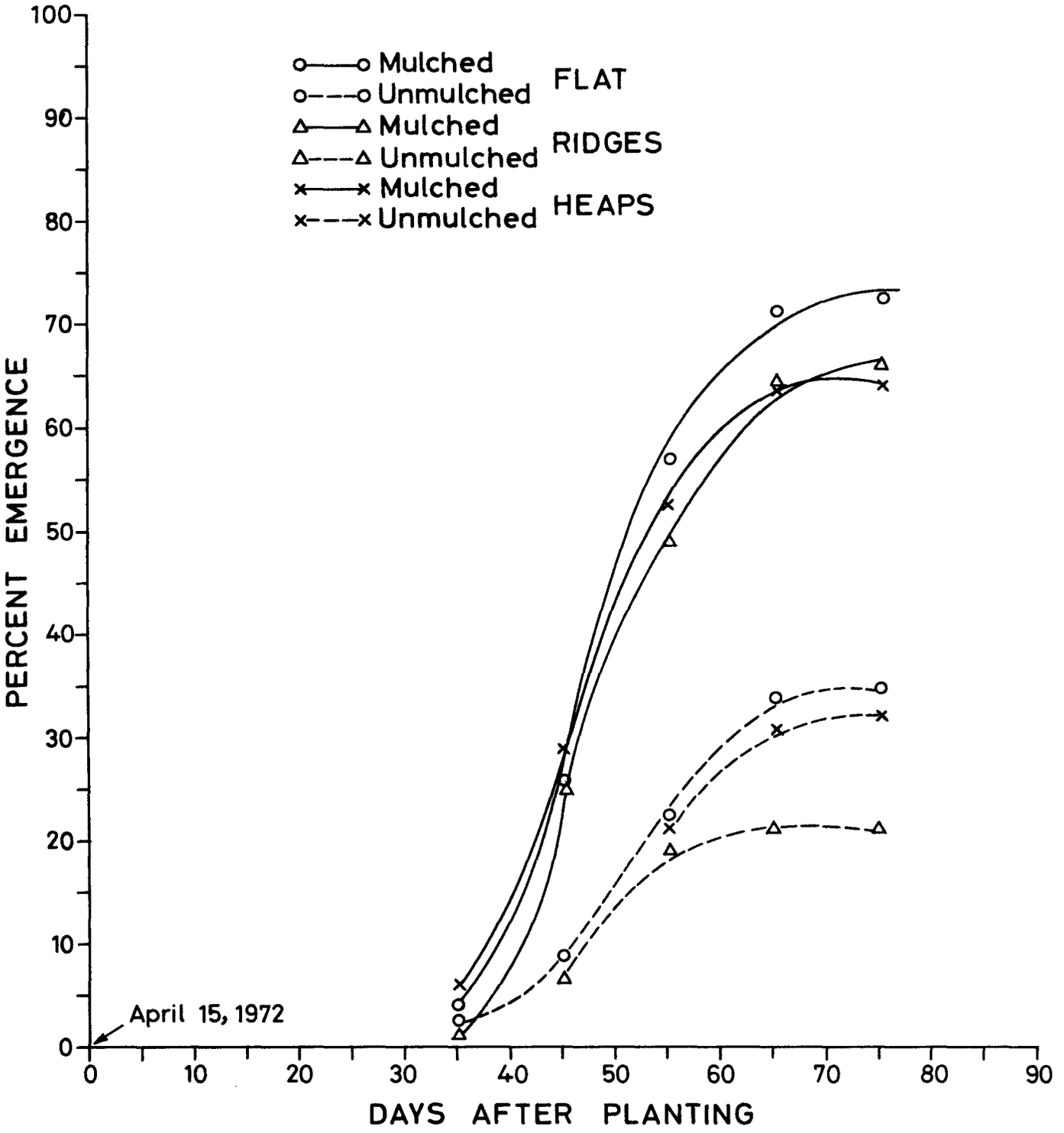


Figure 6. *Effect of seed bed preparation and mulching on rate of emergence for planting on April 15, 1972.*



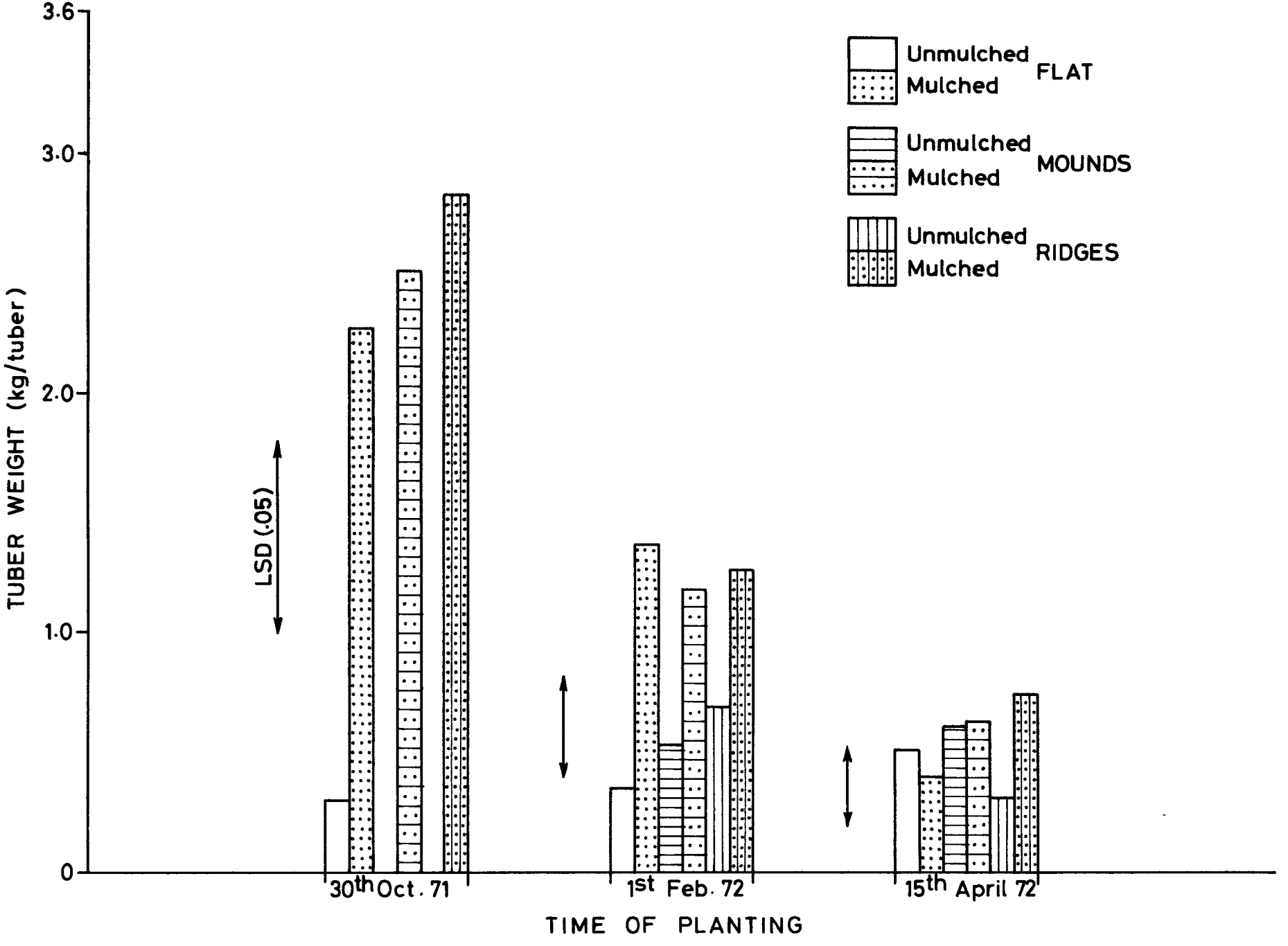


Figure 7. *Tuber size as affected by seed bed preparation, mulching and time of planting*

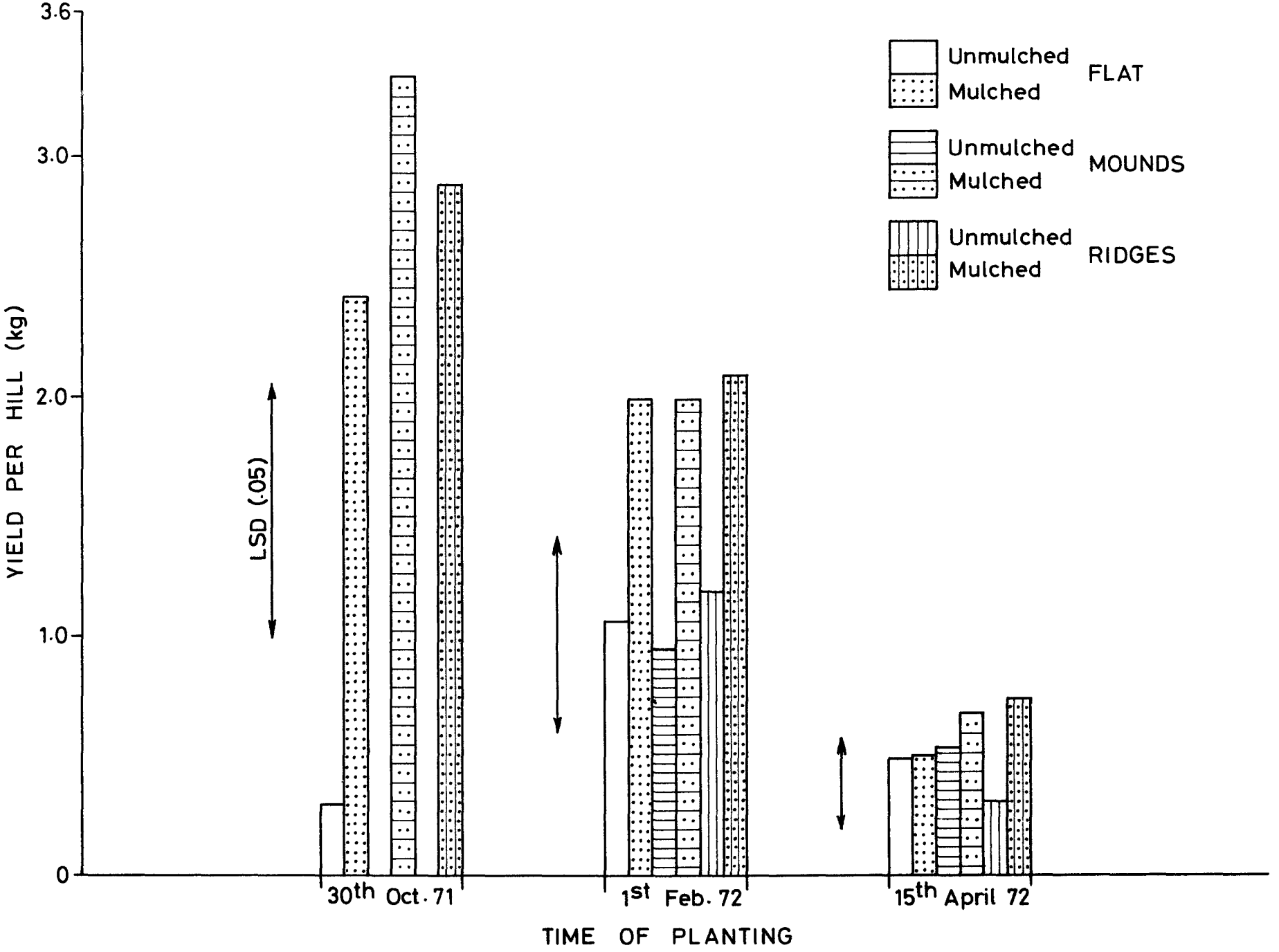


Figure 8. *Yield per hill as affected by seed bed preparation, mulching and time of planting.*

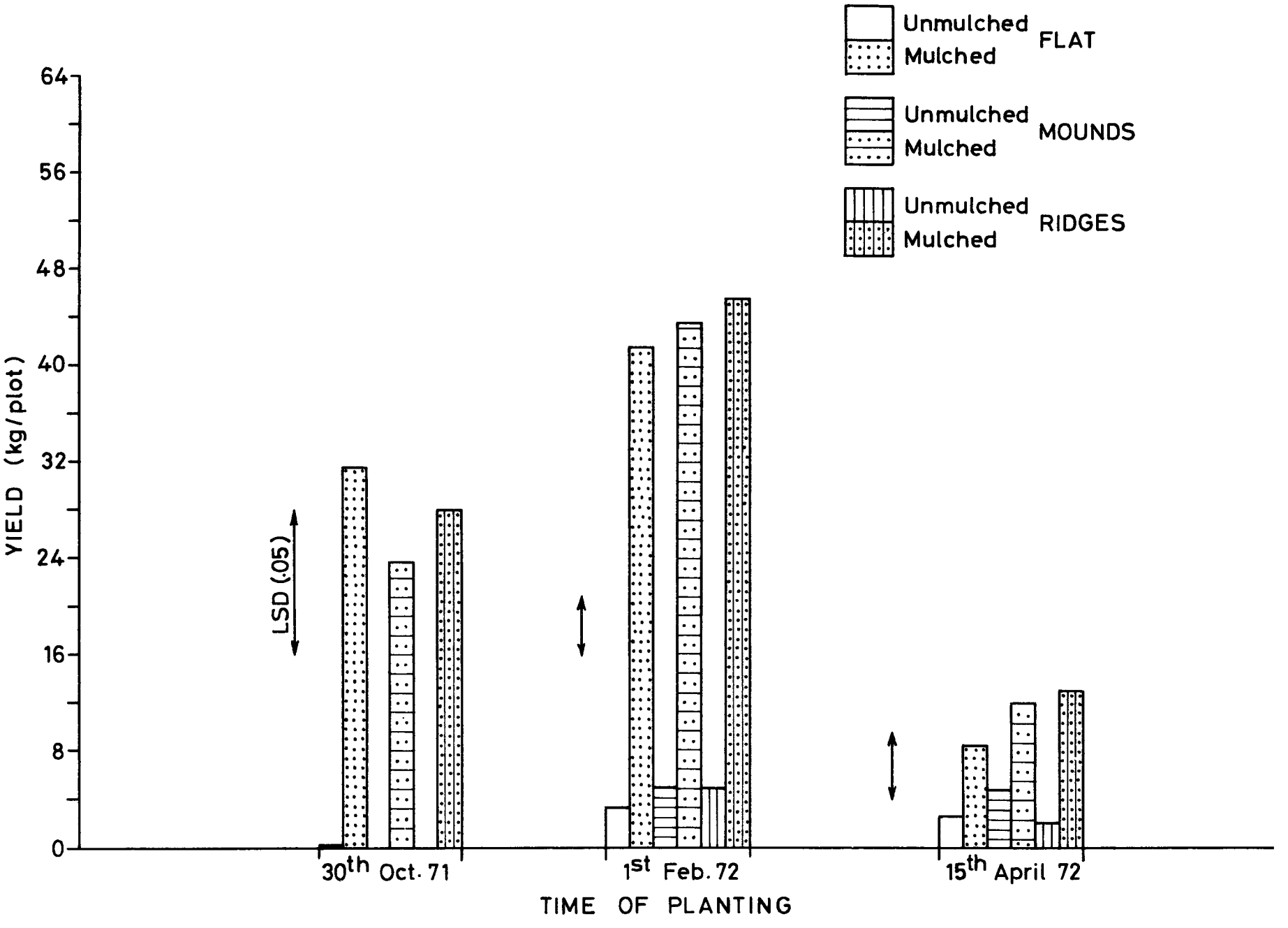


Figure 9. *Total yield as affected by seed bed preparation, mulching and time of planting.*

TABLE 1

Effect of method of seed bed preparation and mulching on time of emergence for different dates of planting yam setts

Surface treatment		Time in days to first emergence*		
		Planted Oct.30, 1971	Planted Feb.1, 1972	Planted April 15,1972
Mulched	Flat	75	26	30
	Heaps	127	40	30
	Ridges	122	32	31
Unmulched	Flat	148	48	37
	Heaps	+	55	40
	Ridges	+	52	50

* Average of four replications
\+ No emergence

TABLE 2

Analysis of variance - table of F ratio effects of treatments on total yield

Variable	F ratio for various planting dates		
	Oct. 30, 1971	Feb.15, 1971	April 15, 1972
Mulching (M)	71.4	30.1	889.64
Seed bed (S)	0.5	1.33	1.39
M x S	0.1	1.07	

TABLE 2

Mean cumulative yields* or 'milked' and replanted setts expressed in kg fresh weight of tubers per plot and as percentages of controls or unmilked setts yield

Species or cultivars	Milking treatment	A First planting date		B Second planting and milking date		C Third planting and milking date	
		Yields (kg)	% of control (A_a)	Cumulative yield of milked sett (b)	% of control (A_a)	Cumulative yield of milked sett (b)	% of control (A_a)
1. *D. rotundata* (cv. Aga)	a. control						
	b. milked setts	38.5	85.2	54.5	120.6	54.6	120.8
2. *D. alata*	a. control	47.6					
	b. milked setts	40.8	85.7	59.8	125.5	61.6	129.4
3. *D. dumetorum*	a. control	22.0					
	b. milked setts	20.3	92.3	24.0	109.1	24.0	109.1
4. *D. rotundata* (cv. Abi)	a. control	35.6					
	b. milked setts	42.2	118.5	56.0	157.3	56.4	158.4
5. *D. cayenensis*	a. control	25.8					
	b. milked setts	23.6	91.5	23.9	92.6	23.9	92.6

* Mean yields are based on individual plots of 20 plants each replicated three times.

TABLE 3

Mean yields* (in kg fresh weight of yam tubers) per plot and percentages of tuber yields from milked setts as compared with control (unmilked setts) yields at different planting and milking dates

Mean yields* (in kg fresh weight of yam tubers) per plot and percentages of tuber yields from milked setts as compared with control (unmilked setts) yields at different planting and milking dates

Setts milking treatment		A First planting date	B Second planting and milking date	C Third planting and milking date
(a) control	Yield(kg)	35.2	23.8	2.1
	Percentage	100	100	100
(b) milked setts	Yield(kg)	33.1	10.6	0.5
	Percentage	93.99	44.5	23.6

* Each yield figure is a mean of 20 yam stands of five yam species or cultivars replicated three times.