

Full Length Research Paper

Effects of staggered planting dates on the control of *Thrips tabaci* Lindeman and yield of onion in Nigeria

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Eight-week old onion seedlings were transplanted from December to April in 2001-2002 and November to March in 2002-2003 growing seasons to assess the level of thrips damage and its effect on onion bulb yield. Results obtained revealed that thrips started appearing from January but the number was very low until end of February when the population reached 12 thrips/plant. November transplant was free of thrips up to 9 weeks after transplanting (WAT), December transplant up to 8 WAT, January transplant up to 6 WAT, while February, March and April transplant had population of >5 thrips /plant at 4 WAT. There was a significant difference ($P < 0.05$) between plantings from 4-14 WAT. The peak of thrips incidence in the various transplants were as follows: November at 15 WAT (120), December at 12.5 WAT (234), January at 9.5 WAT (373), February at 8.5 WAT (217), March at 6 WAT (41.2) and April at 5 WAT (20). Onion bulb yields were also found to differ in descending order as follows: November (48 t/ha), December (42 t/ha), January (13.5 t/ha), February (5.5 t/ha) and March (1.5 t/ha).

Key words: Onion, *Thrips tabaci*, weeks after transplanting.

INTRODUCTION

Onion as a major spice item in the Nigerian diet, and ranked among the most important vegetable in Nigeria based on the level of consumption and other uses (Nihort, 1986). Mature onion bulbs are eaten raw as salad. They are cooked in a variety of ways such as fried, boiled and roasted (Kochar, 1986; Purseglove, 1992). Green onion leaves and white leaf bases before the bulbs are formed are eaten raw, alone or in Salads (Purseglove, 1992).

Cultivation is carried out both during the wet season from June through October and during the dry season from December through May (Ebenebe, 1980) but the bulk of the crop is grown in the dry season, mostly in the northern part of the country. Green (1973) found that it can be very difficult to grow an onion bulb crop in the wet season because only two wet season trials were successful in two years and yields were less than 5 t/ha.

Onion is attacked by several pests that seriously reduce yield by stunting or kill the plants. Crop quality is frequently impaired by thrips. Onion thrips are polyphagous and have been recorded on more than 300 species of

plants (Straub and Emmett, 1992). John and Mann (1963) considered them to be the most severe pests of onion and their allies and attacks by thrips can totally destroy young plants.

Thrips tabaci (L.) feeds on sap from leaf epidermal cells, which become air-filled and thereby exhibit silvery sheen that is characteristics of damage by this insect (Jones and Jones, 1974). Infested leaves may become twisted. Young onion plants are more susceptible and may be killed by heavy thrips attack (Lewis, 1973). Raheja (1973) observed that damage by thrips in early stages of crop growth would seem to be more important and is likely to result in substantial reduction in yield. Anon. (2004) found that large number of thrips kill onion seedlings, while damage to older plants by thrips may cause crops to mature early and, subsequently reduce yields. Thrips can also act as vectors of virus diseases. Onion is an important vegetable in Sokoto state and this was observed to be seriously affected by onion thrips, necessitating farmers to spray at different times of the growing season. Farmers apply chemicals indiscriminately, whenever presence of thrips is noticed on onion. Therefore this study was conducted to study the population dynamics of onion thrips and what yield could be obtained from the different planting dates. Transplanting

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of onion seedlings was done from November- April to assess the impact of population pressure of thrips and the effect on yield.

MATERIALS AND METHODS

Field experiments were conducted at Kwalkwalawa in Sokoto State, Nigeria, about 5 km from the main campus at the Teaching and Research Farm of the University. The experimental site is located on latitude 13° 01' N and longitude 05° 15' E, 300 m above sea level. Annual rainfall in the area ranged from 730 - 790 mm and lasts from April- October. The temperature in the area varied from 25 - 35 °C.

Seedlings of Ex-Gidan Kwano, a local variety were raised in the nursery in the field for 8 weeks in seedbeds before transplanting. Treatments consisted of five transplanting dates in December, January, February, March and April in 2001-2002 and November, December, January, February and March in 2002-2003. The treatments were arranged in a randomized complete block design, replicated three times. The experimental plot was 2.5 by 1.5 m accommodating 5 rows each with 17 plants/row at a spacing of 30 cm between and 15 cm within rows. The plot size was 3.75 m², containing 85 onion plants. Poultry manure was applied before transplanting in each planting date at the rate of 10 t/ha. This was followed by application of 90 kg N, split into 2 at 2 and 6 weeks after transplanting. Data collection on thrips started from 4 to 14 WAT. Two plants were sampled from every plot; one per row to determine the number of thrips in them. Systematic sampling was used in sampling by cutting the plants at the base. During exploratory trials, it was observed that onion had the ability to regenerate and older plants look very similar to regenerated plants or plants from which sampling was done, the only distinguishing feature was corrugation of leaves that were excised. The sampled plants were placed in labelled polythene bags, which were taken to the laboratory and kept in a refrigerator to fully immobilize the insects for 24 h. Thrips were counted in the laboratory using binocular microscope. Yield data were taken by sampling the middle row (single row), measuring 2.5 m. Onion bulbs were harvested by pulling of bulb and where it was difficult a small hoe was used to remove them. Roots from harvested bulbs were removed and weighed using metler balance immediately before curing. The data were analyzed using statistical analysis system (SAS).

RESULTS

The results of the effect of date of transplanting on the population of thrips are presented in Figures 1 and 2. Figure 1 shows that sampling for thrips in 2001-2002 started in the first week of January for the 1st transplanting, first week of February in the 2nd transplant, first week of March in the 3rd transplanting, first week of April in the 4th transplanting and last week of April in the 5th transplanting. In 2002-2003 session transplantings were done a month earlier in all the transplantings and also the sampling. The two figures indicate that irrespective of the date of transplanting there are fewer thrips on onion in December and January.

Figure 1 has shows that less than 5 thrips per plant were recorded on onion in January but in February the population rose up to 60 thrips/plant in the first transplant. The population continued to rise in March, where the peaks in 1st, 2nd and 3rd transplanting were in March with

224, 286 and 218 thrips/plant, though the 3rd transplant had two peaks; in March and April. The 4th transplanting was done when the thrips population was high and since the transplanted plants were small, it was not likely that they would support high population, when already the older crops had provided shelter to the thrips.

The trend in 2002-2003 depicted similar pattern except that the peak population was 1.5 times more than in the previous session. The 3rd transplanting in 2002-2003 when compared with the 2nd transplanting in 2001-2002 indicated that the peak was about the second week in March. Also by comparing the 2nd transplant in 2002-2003 (243) with the 1st transplant in 2001-2002 (224) peak population was between 1st and 2nd week of March.

The effect of dates of transplanting on the sizes of bulb and yield of onion bulbs are presented in Table 1. Onion plants transplanted on November 12 and December 10 and 11 had the highest number of bulbs per row when compared to the latter dates of transplantings. In 2001-2002 season, the mean number of bulbs/row in onion plants transplanted on December 11, January 8, February 5 and March 5 were 16, 15, 12 and 7, respectively. In 2002-2003 season, the corresponding figures were 17, 13, 13 and 11. Similarly, the wet and cured weights of harvested bulbs were also influenced by the dates of transplanting (Table 1). In 2001-2002 season, the mean cured weight of onion bulb/row in transplantings made on December 11, January 8, February 5 and March 5 were 2.96, 1.12, 0.39 and 0.09 kg/row. Similar trends were also obtained in 2002-/2003 season. Yields translated to tons/ha in 2001-2002 were 39.5 for the December 11 transplant and 1.3 for the March 5 transplant. In 2002-2003 season, it was 47.7, 43.7, 11.6, 6.2 and 1.5 tons/ha for November 12, December 10, January 7, February 4 and March 3 transplantings respectively.

DISCUSSION

Planting and transplanting were staggered in order to assess whether early planting had any advantage in reducing insect pests and increasing bulb yield of onion. Figures 1 and 2 indicate that population of thrips was low up to the third week of February even on the early transplant and would therefore require no insecticidal spray. This supported the findings of Pollard (1955), which reported that careful selection of sowing date makes it possible to ensure that the vulnerable stage in a crop does not coincide with the period of pest abundance. Workman and Martin (2002) reported that a population of 60 thrips/plant resulted in plant damage and shorter leaves. This was also in agreement with Kranz et al. (1977), which found that the crop can be protected by bringing forward the planting date so that the maximum population of thrips does not coincide with the seedling stage. Lewis (1973) observed that time of sowing and harvesting crops can also reduce the severity of injury. Kisha (1977) stated that early transplanted onions were

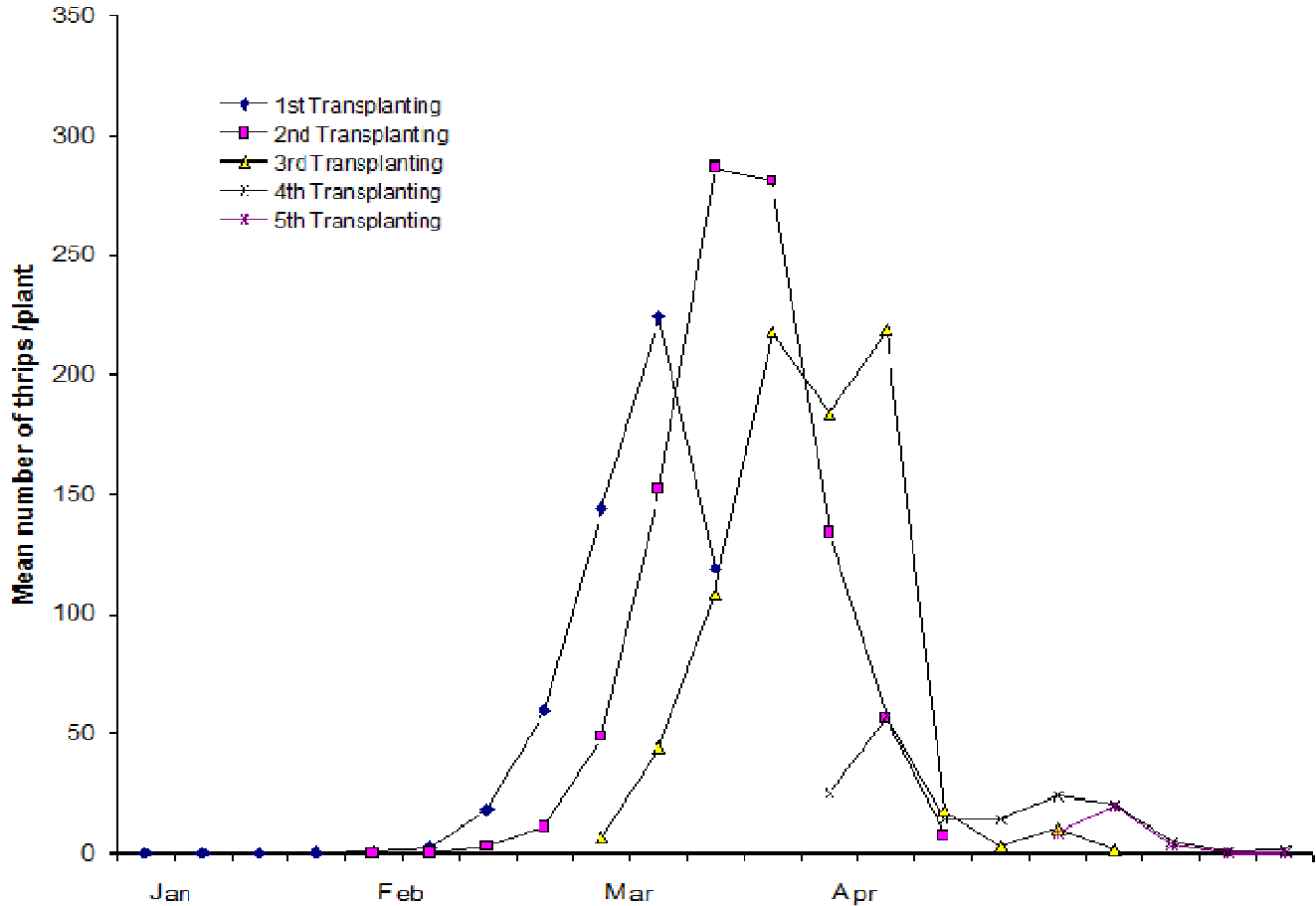


Figure 1. Thrips populations in 2001-2002 growing season at different planting periods.

usually well established before attack began in mid-February of 1970-71 and Kisha (1979) added that a mean number of 5-10 nymphs/plant be adopted as a critical level at which commencement of control measures can be made. However, Edelson et al. (1989) noted that insecticide applications were initiated when populations of thrips increased above one thrips/plant. If left unsprayed such a population would reach peak levels soon afterwards. The possible reason why this occurred was the parthenogenetic nature of thrips (Shelton et al., 1982). Adesiyun (1981, 1982) found that damage caused by shootflies to sorghum planted early in the season was low and insignificant and this low population was on the scanty vegetation during the dry season. In this study, the population of thrips was low probably because many suitable hosts were unavailable and breeding sites inundated. Reuda and Shelton (2003) reported that at the end of the season, however, thrips might not be able to survive in abundance because there is not sufficient green vegetation in the surrounding areas, April and May being the driest months of the year. They added that from June-September heavy rains maintained thrips population at low levels in native vegetation where they were not treated.

The population of thrips was low up to the middle of February for November and December transplants (Figures 1 and 2). In Figure 2 the population on March transplant was above 100 thrips/plant and this agreed with Malik et al. (2003) that on March transplant thrips appeared in the second week of April and maximum number of thrips was 162.4/plant, in which yield reduction was up to 20.76%. It is therefore obvious that these crops were not attacked by thrips up to eight or nine weeks after transplanting, about the time of maximum height and three weeks in bulbing after which the number was higher than the recommended threshold of five thrips/plant. The number of thrips was low in February probably because the temperatures are relatively low, 25 - 26°C, which also agreed with Franssen and Huisman (1958) reported that infestation of *Thrips angusticeps* Uzel during rainy and cool seasons were significantly lower than those during dry and hot seasons, presumably because of high larval mortality and slower population growth rates (Kirk, 1997). Also Morsello et al. (2008) observed that seasonal aerial trapping from 1997 through 2001 showed very little movement of both *Frankliniella fusca* Pergande and *T. tabaci* from January through March of each year. During early April and May, move-

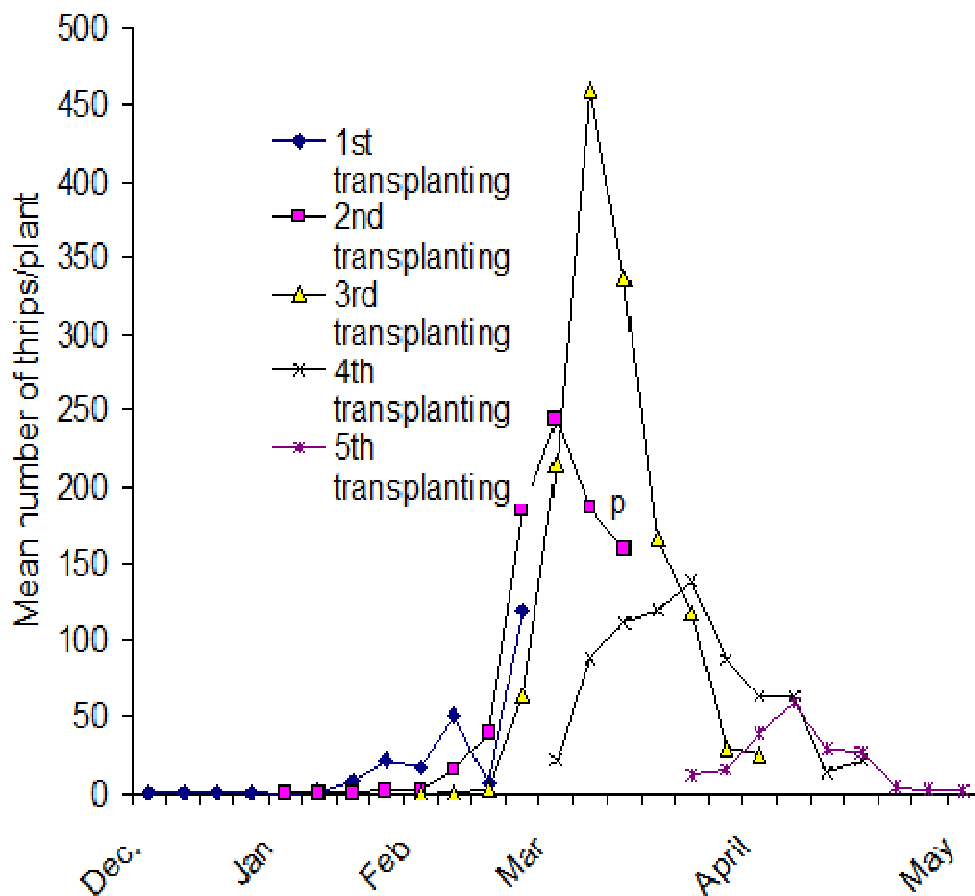


Figure 2. Thrips population in 2002/2003 growing seasons at different planting periods.

Week after transplanting	SE values
4	1.96
5	5.22
6	5.30
7	12.23
8	12.32
9	27.80
10	13.60
11	35.30
12	16.37
13	16.98
14	14.52

movement increased for *F. fusca* or *T. tabaci* and on average, peaked between 10 and 31 May each year. The magnitude and the timing of the flights varied greatly among individual sites and years.

Onion yield (Table 1) obtained indicated that there were variations between years with 2002-2003 season having higher yield than the corresponding crop in 2001-2002 season, although thrips population was higher in the latter than in the former. The only exception was in the Jan.

transplant and this may be attributable to high insect population in 2002-2003 season as compared with 2001-2002 season. The general trend recorded in respect of yield confirmed the findings of Edelson et al. (1989) that even though there were fewer thrips in the full season plots in 1987, the total onion yield in terms of bulb weight and % jumbos was less than in 1986. They further stated that weather might be the major factor influencing total yield. They observed that in years with favourable weather for onion production, a grower would increase profits by controlling thrips population. Additionally, in years with unfavourable weather conditions for onion cultivation, the lack of thrips management might result in net losses to a grower.

One may therefore expect a taller plant with more leaves to have better ability to photosynthesize than the shorter one with fewer leaves. Harding (1961) stated that these insects are known to occasionally reach damaging levels, although they do not reduce yields, unless the population is high, and Straub and Emmett (1992) added that when young plants are severely damaged, the loss of photosynthetic areas could cause death.

It was noticeable that yield in 2001-2002 season was lower than 2002-2003 season despite the higher number

Table 1. Effect of date of transplanting on bulb yield of onion in 2001-2002 and 2002 –2003 growing seasons.

2001-2002 season						
Date of transplanting	Mean No. bulbs/row	Mean Wet wt. (kg/row)	Mean Wet wt. (g/bulb)	Mean Cured wt. (kg/row)	Mean Cured wt. (g/bulb)	Mean Cured wt. (tons/ha)
11/12/01	15.93	3.107	194.0	2.966	185.0	39.546
8/1/02	14.67	1.231	83.0	1.122	75.0	14.969
5/2/02	12.40	0.456	37.0	0.390	31.0	5.200
5/3/02	6.53	0.101	15.0	0.095	14.0	1.249
P	0.001	0.001	0.0001	0.0001	0.001	0.001
LSD	1.461	0.289	0.015	0.030	0.0156	4.011
SE	0.51	0.011	0.005	0.10	0.005	1.40
CV (%)	15.95	32.03	25.21	35.57	27.63	25.89
2002-2003 season						
Date of transplanting	Mean No. bulbs/row	Mean Wet wt. (kg/row)	Mean Wet wt. (g/bulb)	Mean Cured wt. (kg/row)	Mean Cured wt. (g/bulb)	Mean Cured wt. (tons/ha)
12/11/02	13.93	3.804	273.0	3.580	257.0	47.733
10/12/02	16.60	3.483	210.0	3.280	198.0	43.734
7/1/03	12.80	0.967	76.0	0.871	68.0	11.608
4/2/03	12.93	0.538	41.0	0.467	36.0	6.222
4/3/03	10.93	0.139	12.0	0.116	10.0	1.544
P	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
LSD	1.580	0.330	0.018	0.316	0.016	4.213
SE	0.55	0.11	0.006	0.11	0.005	1.48
CV (%)	16.01	25.19	19.44	25.89	19.83	25.89

of thrips recorded in the 2002-2003 season (Table 1). This might be due to early invasion of thrips in 2002-2003 resulting from early transplanting made in November and thrips could not reduce yield in 2002-2003 season when compared with 2001-2002. Since the crops in 2002-2003 season were taller than corresponding crops in 2001-2002. Localized tissue necrosis from feeding reduces photosynthetic ability and nutrient availability to the plant for setting and sizing the bulbs resulting in reduced yields (Coviello and McGiffen, 1995).

There was a reduction in yield in a ratio of 2 - 4 (Figure 1) between successive months and this in agreement with Kisha (1977), which found that early transplanted onions produced significantly higher yields than onions transplanted later. He noted that low yields of onion transplanted from December onwards were attributable to thrips damage on the young plants, so that to obtain reasonable yields, insecticides had to be applied. Raheja (1973) also stated that early stages of growth are likely to be more sensitive to loss of sap due to feeding of the thrips and damage. Early stages of crop growth would seem to be more important and is likely to result in substantially reduced yield (41 %). Young onion plants are more susceptible and may be killed by heavy thrips attack (Lewis, 1973). Similar trends have been reported in other crops, for example, soybean (Shepard et al.,

2001) and groundnut (Farrel, 1976).

It is clear that the effect of transplanting date alone showed that up to 47 t/ha could be attained from November transplant, 40 - 44 t/ha in December transplant, 12 - 15 t/ha in January transplant, 5 - 6 t/ha in February transplant and 1 - 2 t/ha in March transplant. In Figure 1, it is evident that there was up to 62% reduction in yield between December and January transplants in 2001-2002 season, and up to 73% in 2002-2003 agreeing with Kisha (1977) which observed that in Sudan, light infestations by thrips on late transplanting of onion led to yield loss of 40%, while severe attacks reduced yield by almost 60%.

It can be deduced that at later stages the plant can tolerate high thrips population without impairing the yield. The reason may be that thrips are sapsuckers and could only cause serious damage if the plant was at either at the early stage (stunting) or at the critical stage of bulbing, reducing the yield. It can therefore be concluded that from 9-14 WAT even if relatively lower number of thrips was recorded on the crop earlier devastated by thrips, it was difficult for the crop to recover and produce any substantial yield.

In contrast to the above, Stoner and Shelton (1988) reported that the severity of thrips damage was much lighter on late planted plots than those planted earlier. They noted that farmers could reduce thrips damage on

their cabbage heads by planting susceptible varieties late in the season. However, Edelson et al. (1989) observed that onion plants might be differentially sensitive to thrips injury depending on plant phenology. The above corroborated Kendall and Capinera (1987) that the greatest influence on yield by onion thrips occurs during the bulbing stage and that under greenhouse conditions, a total of 10 thrips/plant reduced yield by 7%. In contrast, Mayer et al. (1987) reported no relationship between reduction in thrips population and yield increases in Washington. Edelson et al. (1989) attributed lack of yield response by onion thrips injury in Washington to possible differences in varieties (long-day and short-day bulbing onions), levels and timing of thrips control and climate. When young plants are severely damaged, the loss of synthetic area can cause death (Straub and Emmett, 1992).

In these trials, there was not much difference between temperatures and relative humidity in the two seasons (2001-2002 and 2002-2003), but wind speed showed that there was stronger wind in 2001-2002 season than in 2002/2003. Several workers have reported a threshold of 10 thrips/plant (Steene et al. 1999; Mau and Gusukuma-Minuto, 1999; Straub and Emmett, 1992; Raheja, 1973; Kisha, 1979). Therefore, a population of ten thrips/plant on February transplant at the beginning from 5-10 WAT and 12 WAT in 2001-2002 season and 4-13 WAT in 2002-2003 season was high enough to cause yield reduction (Table 1). Lorbeer et al. (2002) stated that because the timing of thrips infestation is variable, some plants are attacked at a younger developmental stage than others; consequently, economic thresholds for treatment should be dynamic, based on the size of the plant. Coviello and McGiffen (1995) however, pointed out that a population of 81.8 thrips/plant was high enough and that the plant became so desiccated that they could not support the thrips population.

It can therefore be concluded from the foregoing that *T. tabaci* is the major insect pest of onion in Sokoto State as reported world wide and that the pest can be effectively managed by early planting/transplanting with bulb yields of up to 48 t/ha in the early transplanting, while delayed planting gave 2 t/ha.

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