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Yield of Sweet Corn (*Zea mays* ssp. s*accharata*) in Response to Duration of Weed Competition

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Abstract

There is increasing evidence that effective weed control remains critical for optimum sweet corn production. To investigate the critical period of weed competition in the crop, a field experiment was carried out at the Teaching and Research farm of the Federal University of Technology, Minna, Nigeria in the rainy seasons of 2012 and 2013. Six weed competition duration namely; season-long weed free (WF) period, weed free from 15, 30, 45, 60 days after sowing (DAS) and no weeding throughout the season (weedy check-WDY) were laid out in a randomized complete block design with three replications. Results indicated that weed dry weight increased significantly as duration of weed competition was prolonged beyond 30 DAS. Similar superior weed control efficiency was recorded in season long WF period, WF from 15 and 30 DAS beyond which it declined. The longest and largest cobs and heaviest kernel were recorded in WF all season and WF from 15 DAS. Fresh cob yield reduction due to duration of weed competition was pronounced during the period from 15 DAS to full season weedy check by 11.6 to 56.4%. These results suggest that the critical period of crop weed competition in sweet corn lies between 15 and 30 DAS; which was also an indication of the need for early weeding for maximum fresh cob yield.

Keywords: *Sweet corn, sub-humid savannah, weed control, weed competition duration, yield*

Introduction

Sweet corn (*Zea mays* ssp. s*accharata*) is an important vegetable primarily grown for its immature green ear, as food for man (Sani *et al*., 2011). It is consumed in roasted, boiled or raw form and can also be added to salad, among other food ingredients (Jibrin and Sarkin-Fulani, 2011, Akintoye and Olaniyan, 2012). It is distinct from other types of maize because of its ability to produce and retain large amount of sugar within the kernel (Jibrin and Sarkin-Fulani, 2011). Substantial evidence has shown that the production of sweet corn in Nigeria is gradually gaining prominence especially around cities and areas with export capacity (Sani *et al*., 2011).

The crop is a poor competitor with weeds because of its shorter and less developed nature; such that weeds have remained one major limiting factor affecting its production (Simic *et al*., 2012). In general the extent of critical period of weed competition in a crop differs due to the nature and status of the crop, weed species composition present, level of weed infestation, as well as the prevailing environmental conditions (Ijlal *et al*., 2011). In this regard, Williams II (2010) reported that a substantial yield reduction in sweet corn can be caused even in the presence of low

weed densities. Similarly season long weed interference as reported by several investigators resulted in reduction in sweet corn yield by 15% and 85% in late and early planting (Simic *et al*., 2012). A further review of literature showed that green cob yield losses due to weed infestation in sweet corn were estimated to be up to 56% (Sunitha *et al*., 2010). In order to maintain quality and yield and as well remain competitive in the world market, weed control remains critical in sweet corn production (Robinson *et al*., 2012).

There is, however little information regarding duration of weed competition in sweet corn under the sub-humid savannah condition in Nigeria. Therefore, the objective of this study was to determine the appropriate period for weed control in sweet corn.

Materials and Methods

Experimental site:

Field experiment was conducted during the rainy seasons of 2012 and 2013 at the Teaching and Research farm, Federal University of Technology, Minna ($9^{o}36'$N, $6^{o}33'$E). Minna is located in the southern Guinea savannah and receives an average annual rainfall of 1200 mm, which is highly concentrated between the months of June and August. The average daily temperature in this area rarely falls below 22^{o}C, with peaks of 40^{o}C between February to March and 36^{o}C between November to December, respectively (FDALR,1990; Adeboye *et al*., 2011). The soils of Minna are developed from basement complex rocks, which vary from shallow to very deep soils, and are generally classified as Alfisols (Adeboye *et al*., 2011)

Treatment, experimental design and cultural practice:

The experimental treatments were made up of six durations of weed competition namely; season-long weed free-period (0 WF), WF from 15, 30, 45 an 60 days after sowing(DAS), and no weeding throughout the season (weedy check-WDY). The treatments were arranged in a randomized complete block design (RCBD) with three replications. Gross plot size was 3 m x 4 m (12 m^2) and net plot size was 1.5 m x 4 m (6 m^2). The variety of sweet corn used as test crop was 'Tropical Zea Sweet Corn Yellow (TZSCY)' obtained from IITA, Abuja station, Nigeria. Three seeds were manually sown per hole at an intra–row spacing of 25 cm on ridges spaced at 75 cm apart. Sowing was done on 12 July, 2012 and 13 July, 2013. Sweet corn seedlings were later thinned to one plant per stand at two weeks after sowing. Weeds were manually controlled with hoe as per the treatments. Inorganic fertilizer NPK 15-15-15 was applied at the rate of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} by side-banding at 5 cm beside and below the plant. N was applied in two split doses, such that half of N and full doses of P and K were applied as basal application at 3 WAS, using NPK 15-15-15 as

source. The remaining half of N was applied as urea at 6 WAS. There was no serious outbreak of insect pest and diseases; as such no control measure was taken in the two cropping seasons. Harvesting was done by plucking all the fresh green ears from within the net plot of each treatment at the milk dough stage.

Data collection and statistical analysis:

Weed sampling was carried out at the completion of their weed competition period by randomly throwing two 0.25 m^2 quadrat along a diagonal in each plot. The total above ground part of all weed species within the quadrats in each plot were clipped from the soil level, bulked and oven dried at 70^oC to a constant weight and weighed to obtain the total weed dry weight and expressed in (g/m^2). Weed control efficiency (WCE) was calculated as described by Bhattacharya and Mandal (1988) as;

$$WCE = \frac{\text{Dry weed weight of unweeded control} - \text{Dry weed weight of weed free treatment}}{\text{Dry weed weight of unweeded control}} \times 100$$

The harvested fresh green ears were weighed to obtain green ear yield per hectare. These were further dehusked and weighed to obtain fresh cob yield per hectare. Five dehusked cobs were randomly sampled per plot and used to determine the treatment effects on cob length (cm), cob girth (cm) and 100-kernel weight (g).

The effect of treatments on all the data collected were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of the Statistical Analysis System (SAS, 2002). Treatment means were compared using the Duncan Multiple Range Test (DMRT) at 5% level of probability as described by Duncan (1955).

Results

Weed growth

Weed dry weight differed significantly between the duration of weed competition in 20 12, 2013 and the mean of the two years (Figure 1). Significantly lighter weed dry weight were recorded in plots kept season long WF to WF from 15 DAS in 2012; season long WF to WF from 30 DAS in 2013 and combined mean, which were in turn statistically similar to that of WF from 30 DAS and 45 DAS plots in 2012 only.

Weed control efficiency differed significantly between the duration of weed competitio n in sweet corn (Figure 2). Similar better weed control were observed in plots kept season long WF, WF from 15 and 30 DAS in both years and the mean of the two years. Furthermore, weed interference beyond 30 DAS resulted in substantial poor weed control in sweet corn.

Cob length

Figure 3 shows that cob length differed significantly due to weed competition duration in 2012, 2013 and the combined mean. Season long WF and WF from 15 DAS in 2012; season long WF in 2013, and combined mean produced significantly longer cobs, which were

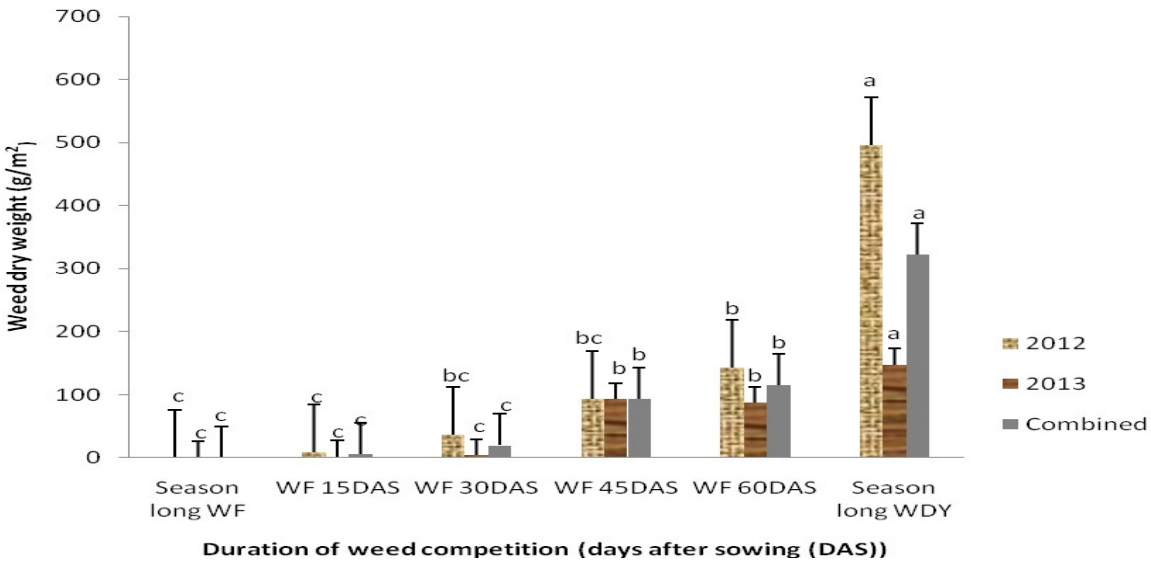

Figure 1: Effect of duration of weed competition on weed dry weight at different periods.

Bars labelled with the same letter(s) in the same year are statistically similar using DMRT ($P \geq 0.05$). Vertical lines represent standard errors of the means.

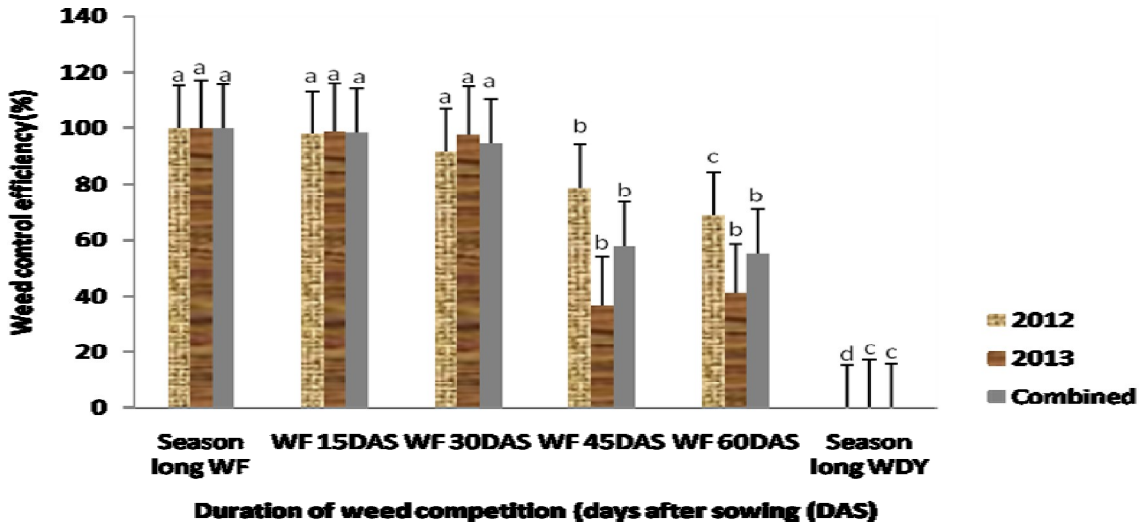

Figure 2: Effect of duration of weed competition on weed control efficiency in sweet corn.

Bars labelled with the same letter(s) in the same year are statistically similar using DMRT ($P \geq 0.05$). Vertical lines represent standard errors of the means.

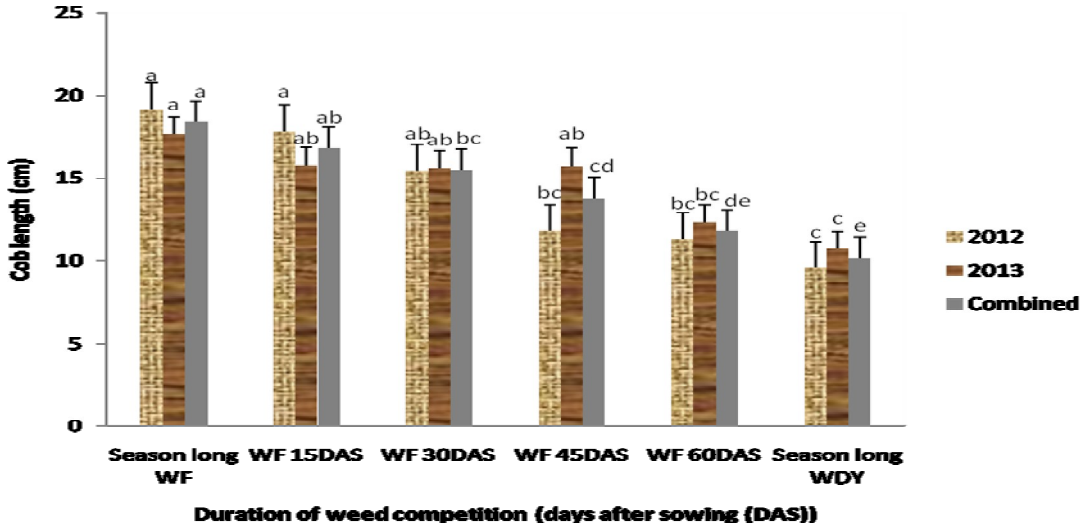

Figure 3: Effect of duration of weed competition on cob length of sweet corn

Bars labelled with the same letter(s) in the same year are statistically similar using DMRT (P≥0.05). Vertical lines represent standard errors of the means.

At par with that recorded in WF from 30 DAS plot in 2012; WF from 15 to 45 DAS plots in 2013, and WF from 15 DAS in the combined mean, respectively. Shorter cobs were recorded as weed competition duration was prolonged beyond WF from 45 DAS in 2012, WF from 60 DAS in 2013 and combined mean.

Cob girth

Cob girth was significantly affected by duration of weed competition in both cropping seasons and the combined mean (Figure 4). Cob girth was biggest in the season long WF and WF from 15 DAS plots in 2012 and the combined mean; and season long WF as well as WF from 30 DAS plots in 2013. The least was however consistently recorded in the weedy check plot.

100 kernel weight

Kernel weight was significantly affected by duration of weed competition (Figure 5). The heaviest kernels were recorded in the season long WF and WF from 15 DAS plots in both years, and season long WF plot in the combined mean; which were in turn statistically similar to all the other plots, except the weedy check plot in 2013, WF from 15 DAS plot in the combined mean only. In contrast, the lightest kernels were recorded in the weedy check which had a season long weed competition with the sweet corn plant.

Cob yield

Cob yield was significantly affected by duration of weed competition in 2012, 2013 and combined mean (Figure 6). Highest cob yield was recorded in season long WF plot which was similar to those in the WF from 15 DAS plot in 2012, season long WF and WF from 15 DAS plots in 2013, and season long WF plot in the combined mean. Furthermore, as the duration of weed competition was prolonged, cob yield reduction gradually increased to the highest value in the full season weedy check (Figure 7). A reduction in cob yield by 44.8, 70.1 and 56.4% in 2012, 2013 and combined mean, respectively were recorded as duration of

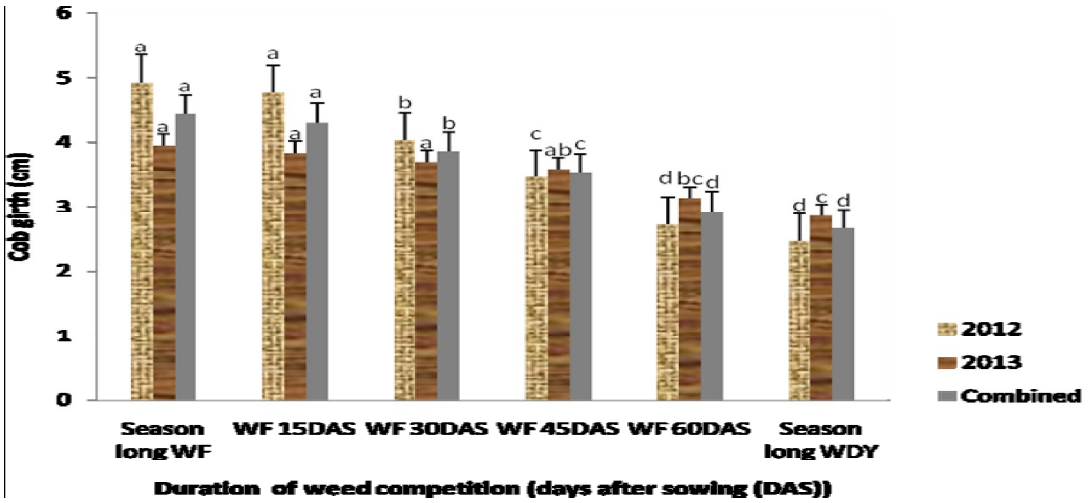

Figure 4: Effect of duration of weed competition on cob girth of sweet corn

Bars labelled with the same letter(s) in the same year are statistically similar using DMRT ($P \geq 0.05$). Vertical lines represent standard errors of the means.

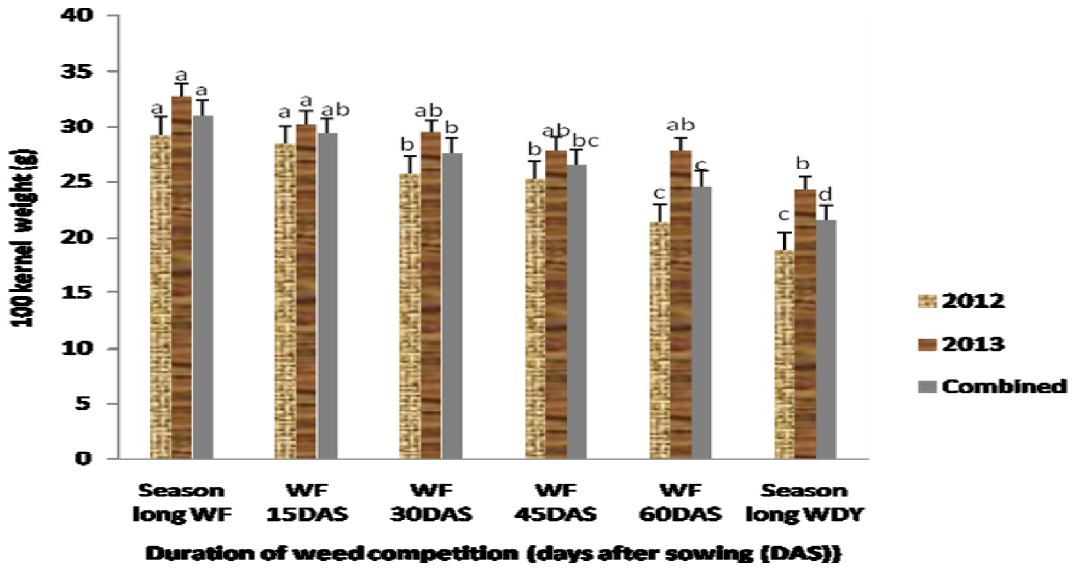

Figure 5: Effect of duration of weed competition on 100 kernel weight of sweet corn

Bars labelled with the same letter(s) in the same year are statistically similar using DMRT (P≥ 0.05). Vertical lines represent standard errors of the means.

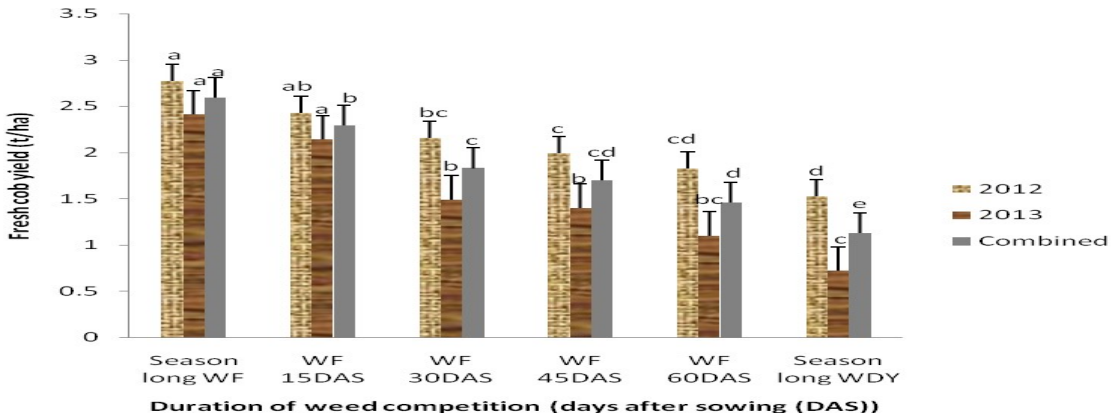

Figure 6: Effect of duration of weed competition on fresh cob yield of sweet corn
Bars labelled with the same letter(s) in the same year are statistically similar using DMRT(P≥ 0.05). Vertical lines represent standard errors of the means.

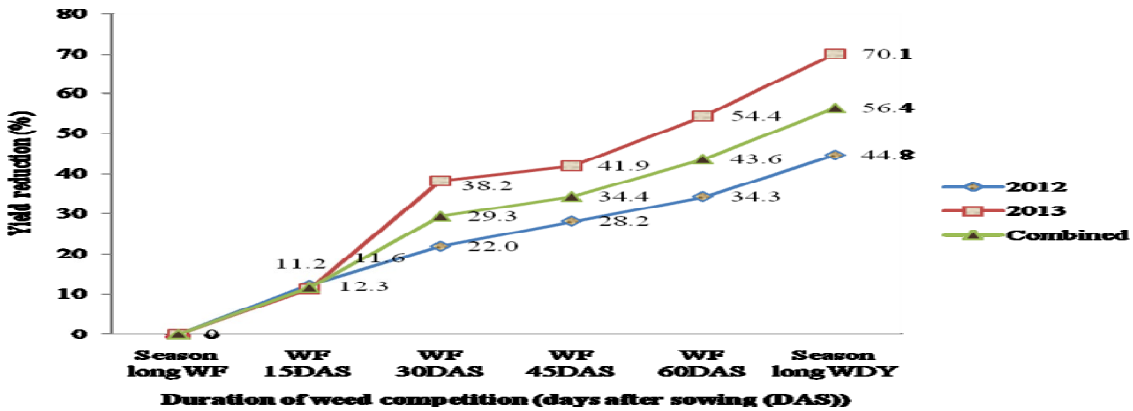

Figure 7: Yield reduction over weed free as affected by duration of weed competition in sweet corn.

weed competition was prolonged from full season WF condition to full season weedy condition in this study.

Discussion

Keeping sweet corn plots weed-free all season and weed-free from 30 DAS resulted in the lowest weed dry matter, hence better weed control. These trends suggests that as duration of time of weeding was prolonged beyond 30 DAS, the weed seedlings present might have acquired enough growth resources and increased in weight, and subsequently exert greater competition on the crop plant. Our result is in line with the findings of Maqbool *et al*. (2006) who obtained maximum weed biomass at 30 days after emergence in maize, and the need to carry out early weeding in this crop.

The longer cobs and heavier kernels recorded in all season weed-free plot and larger cobs in all season weed-free and WF from 15 DAS was a clear demonstration that removal of weeds at the early stage of sweet corn supports maximum use of environmental factors for growth and development in the absence of weed competition effect. These results are similar to that of Maqsood *et al*. (1999) who reported an increase in growth and yield of maize, as the duration of weed competition in the crop decreased.

The highest cob yield obtained under prolonged weed free condition could be associated with the larger and longer cobs, as well as the heavier kernel obtained in this plot. Zystro *et al*. (2012) had noted that sweet corn has to be kept weed free for a longer period in the growing season to avoid significant yield losses, especially if planted early than late. It was also evident that sweet corn fresh cob yield reduction was associated with an increase in weed dry matter production. The decrease in fresh cob yield which ranged from 11.6-56.4% due to weed crop competition period from 15 DAS to full season weed growth (weedy check) was an indication that delays in weed control in sweet corn should not be later than 15 DAS. Sunitha *et al*. (2010) in India reported 40 to 42% green cob yield reduction due to uncontrolled weed growth throughout sweet corn growth period.

Conclusion

Based on the results from this study it can be concluded that early weed control not later than 30 DAS is necessary in sweet corn. This, however, depends on the type and density of weed growth. However to prevent substantial yield loss in sweet corn, weed control could commence from 15 DAS. The current study therefore shows that the critical period for weed removal in sweet corn lies between 15 to 30 DAS within the ecological zone under study.

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