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Influence of Environmental Factors on Population Dynamics of Yellow Stem Borer (*Scirpophaga incertulas*), white Stem Borer (*Scirpophaga innotata*) and Pink Stem Borer (*Sesamia inferens*)

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Abstract: Rice stem borers are notorious insect pests of rice crop and the damage caused by them to crop makes them one of the important pests of rice crop. This was observed that rice insect pests prevail for a specific period. This study was carried out to find the favorable and hostile limits of weather parameters for the rice stem borers. The population was higher from mid-March to first week of May and mid-August to mid-September in case of Yellow Stem Borer and White Stem Borer of rice during the both years 2015 and 2016; while from mid-September to end of April in case of Pink Stem Borer of rice. Insect trap catches recorded higher insects at 22 to 33°C in case of Yellow and White stem borer of rice. Maximum catches were recorded in April and September within a temperature range 26 to 32°C. However, in case of pink stem borer no activity was recorded above 32°C during all the summer season and maximum activity recorded from September to the end of April. Association analysis clearly indicated that there is strong relationship with environmental temperature and activity of borers of rice crop.

Key words: Oryza Sativa · Stem Borer · Population Dynamics · Light Trap Catches · Environmental Factors

INTRODUCTION

Rice is an important cash crop in Pakistan after cotton. It is attacked by many insect pests. Rice stem borers are one of the key pest in subtropical to tropical Asia including Pakistan. Rice stem borers are monophagus such as white stem borer and yellow stem borer to polyphagus pink stem borer. Stem borers form the dead hearts in at vegetative stage while white heads appear after reproductive stage in case of borers' attack [1]. Stem borers attack rice nursery and transplanted crop but their activity observed at peak in the month of September [2, 3] and causes severe losses to the crop [4]. The extent of rice yield losses due to YSB Yellow Stem Borer has been estimated as 20-70 %. [5, 6].

Insect pest population dynamics are considered to be influenced by both biotic and abiotic factors [7]. Environmental elements such as temperature, shower and relative humidity significantly influence the outburst of the insect population [8-10]. Population stem borers like every other species are thus to vary according to the dynamic condition of its environment [11, 12]. Thus, the relation of important factors, both biotic and abiotic, on population dynamics of insect pest could be used to forecast the insect populations. Further, information of the periodic abundance and population trend is vital to warrant timely vigilance to confront future pest problems and preclude crop sufferers [13].

Light traps harvest a large number of species [14, 15] especially those active at night [16] and being cheap provides a number of advantages over other alternative methods. This paper utilize the pest population data collected through light traps during the years 2015-16 which recorded at Rice Research Institute Kala Shah

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Kaku. The light trap data recorded was analyzed to meteorological factors most importantly with temperature and relative humidity to obtain the most significant factor influencing the insect pest population.

MATERIALS AND METHODS

The present investigations were carried out to inquire into the comparative light trap catches of insect pests of rice crop from 2015 to 2016 in the experimental area of Rice Research Institute, Kala Shah Kaku, Lahore, Pakistan. The rice nursery was seeded during the 1st week of June and transferred after one month. All standard recommendations for plant production and plant protection were adapted in accordance with the recommended schedule. The light installed for collection as shown in Fig. 1 had four parts i.e. collection bottle, funnel shaped lid, a bulb of 100W as light source and a top lid to cover it from unexpected rainfall.

Fig. 1:

Potassium cyanide was used to kill the insect pests trapped in the collection chamber. Killing bottles were replaced manually and trapped moths were identified and counted. The meteorological data was collected from Meteorological Department, Lahore, Pakistan.

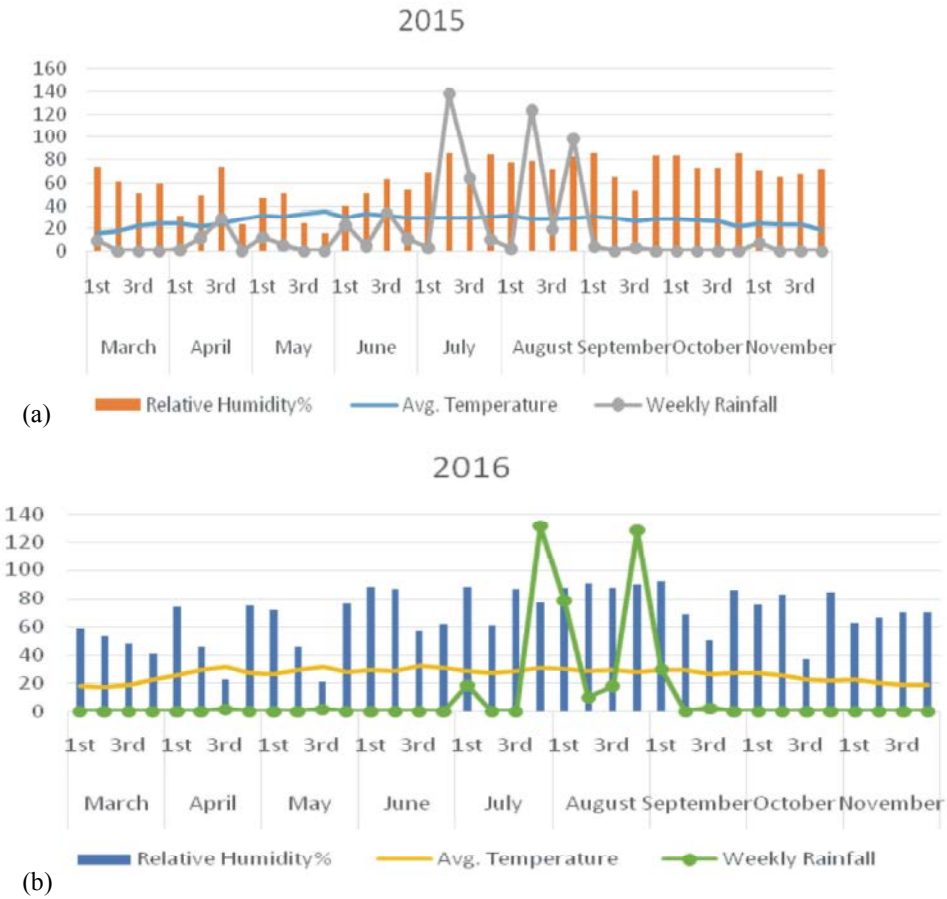


Fig. 2: Weekly total rainfall, percentage relative humidity and average temperature at Kala Shah Kaku for the years, 2015 (a) and 2016 (b)

RESULTS AND DISCUSSION

By comparing the insect light trap catches (Fig. a, b) it is evident that the white stem borer is very active between 22 to 32°C and no flight was observed below 18°C and above 33°C. As shown in the Table (a) and (b) it is clear that polynomial trend line shows no activity below 16°C temperature and zero activity above 33°C for the year 2015. For the year 2016 the upper temperature limit increased one degree i.e. 33°C while it has risen to 18°C in case of lower temperature limit.

Activity of white stem borer started in the third week of March in 2015 when temperature rose to 22°C as compared to 18°C average temperature of 2nd week of March while in 2016 the light trap catches were started in 3rd week of March when temperature was again 22°C as compared to 2nd week of March 18°C. Light trap catches were increased in April when average temperature range was recorded between 26°C to 30°C for both the years 2015 and 2016. Catches were dropped in May for both the years and no catch was observed after 2nd week of May in 2015 when temperature reached to 34°C and 3rd week of May in 2016. No flight was observed from 3rd week of May to last week of July in 2015 while from 4th week of May to 2nd week of August for the year 2016. The maximum flights and catches have been observed between 25°C to 30°C for the both years 2015 and 2016 that range could be defined optimum range for white stem borer of rice (Fig. 2a, b).

The activity of yellow stem borer (Fig. 2c, d) started in 1st week of April and lasted till 2nd week of May for both the years 2015and 2016. It has the lower temperature limit of 18°C while 33°C upper temperature limit for the years 2015 and 2016 respectively. From 2nd week of May to 2nd week of August no flight and light trap catches were observed for 2015 while activity started in 4th week of August in 2016. Maximum catches for early season in 2015 were observed in last week of April when temperature was 29°C while in last week of September at average weekly temperature of 29°C again. In the year 2016 no significant activity was observed in the early season while again maximum activity was recorded in 4th week of September when temperature was 28.5°C The intensity of catches showed that maximum catches were observed between 24°C to 30°C and 26°C to 30°C for the years 2015 and 2016, respectively. After the 3rd week of October no activity was observed in both years and activity cessation for 2015 broken in 1st week of April 2016 when temperature range of optimum 25°C achieved.

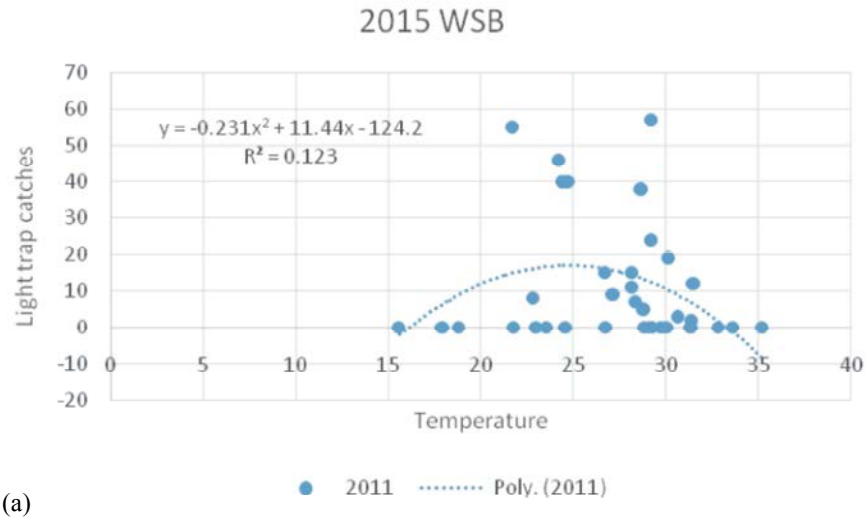
In case of pink stem borer catches were recorded in 1st week of March last till 4th week of April when average temperature reached 31°C for the early season 2015. Then it again started from 3rd week of September in 2015 when temperature dropped to 26°C in 3rd week of August as compared to 31°C during the first fortnight of August for the year 2015. In the year 2016, again activity recorded till the end of 4th week of April while it resumed in the 2nd week of September. The maximum catches range was 22°C to 28°C average temperature for 2015 while below 28°C the frequency of light catches were unanimously divided for the year 2016 in case of Pink Stem Borer. The upper temperature limit was recorded 31°C and 32°C for the years 2015 and 2016 respectively (Fig. 2e, f).

The Pink Stem borer of rice, its activity continues in the winter season being a polyphagus insect pest upon end of Kharif season. Therefore lower threshold temperature limit could not be seen in the Fig. 2 (e, f). More studies are required to figure out the lower threshold limit for Pink Stem Borer.

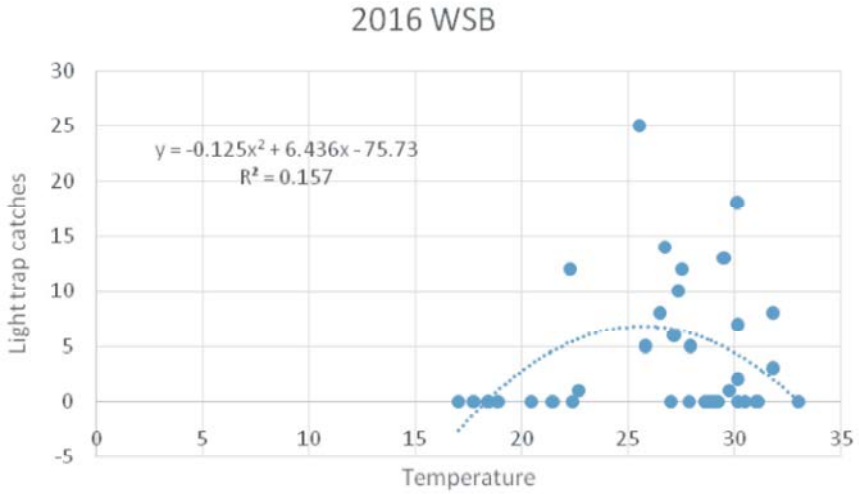
In case of relative humidity, it cast no significant impact on White Stem Borer and a slight positive impact on Yellow Stem Borer of rice. In case of Pink Stem Borer, relative humidity induced a positive effect on light trap catches relative to the White Stem Borer and Yellow Stem Borer (Fig. 3a, b, c) but the number of light trap catches of these three insect pests of rice were increased with increase in average relative humidity.

Our findings are very close to study of Light trap catches of Yellow Stem Borer revealed by Santiago and Sebastian, 1999 that Yellow Stem Borer remained active from last week of March to third week of May in the early season and from September to October a peak of activity was again observed [17]. The studies of [18] also showed that maximum activity of YSB and WSB was detected above at 29°C, while no activity was recorded below 15°C. [19] also found that the overwintering larvae of YSB matures when temperature rise above 16? in spring season similar to our findings. Maximum catches of Yellow Stem Borer recorded were in the month of September (Plant Protection Dept. of Haiphong, 2016) which was in accordance to our studies.

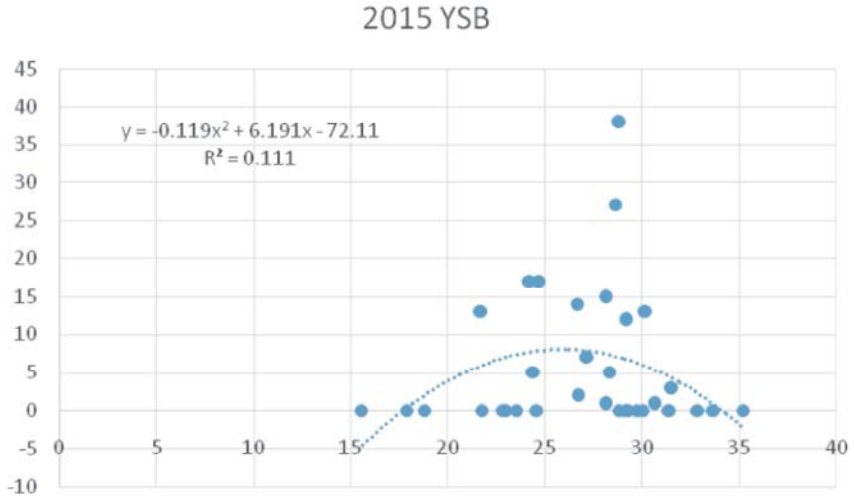
[20] Confirmed the bottom temperatures for growth of YSB for adult phase 16°C similar to our findings explaining further that, constructed on the records for the last 40 years, the appearance of adults of the first generation is depended on the temperatures. Insects belong to phylum arthropoda are cold-blooded creatures, temperature plays a pivotal role in their growth and dissemination [21, 22]


2015 WSB
y = -0.231x² + 11.44x - 124.2
R² = 0.123
Light trap catches
Temperature
2011
Poly. (2011)

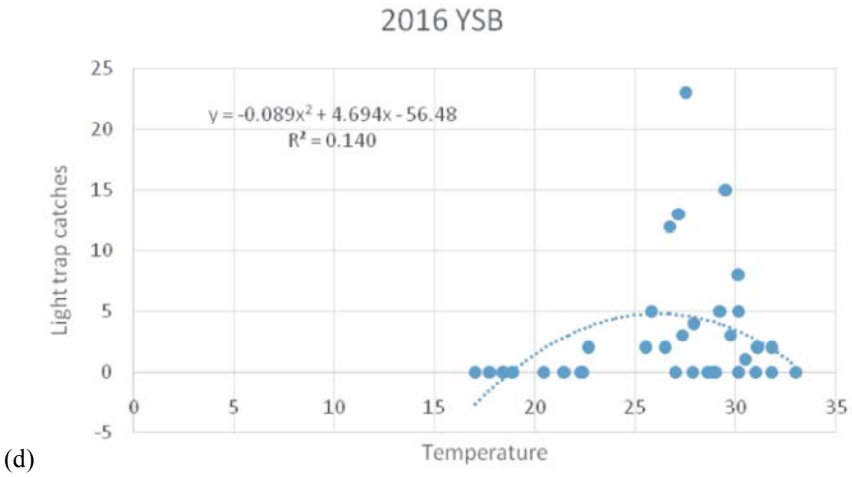
(a)


2016 WSB
y = -0.125x² + 6.436x - 75.73
R² = 0.157
Light trap catches
Temperature

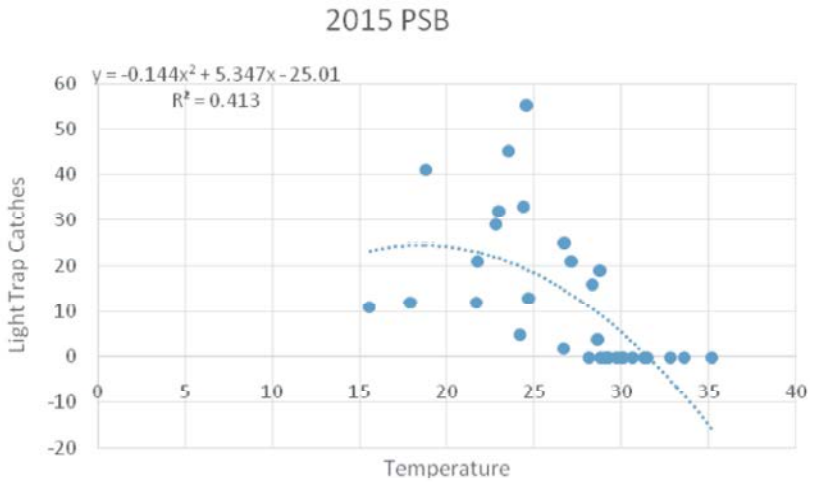
(b)


2015 YSB
y = -0.119x² + 6.191x - 72.11
R² = 0.111

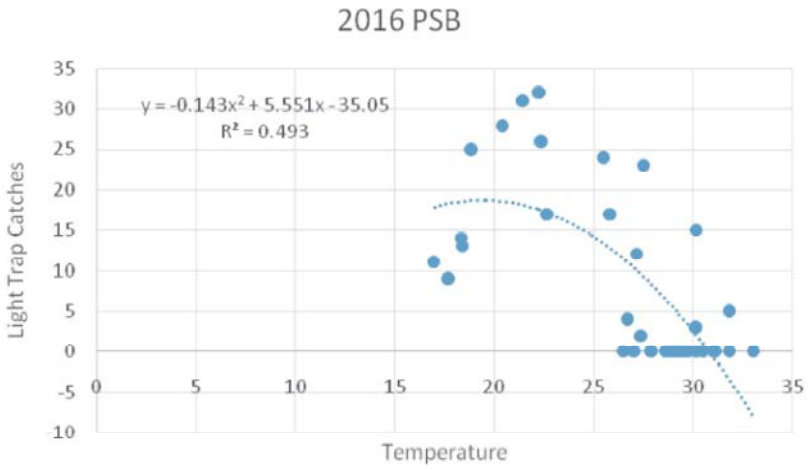
(c)



(d)

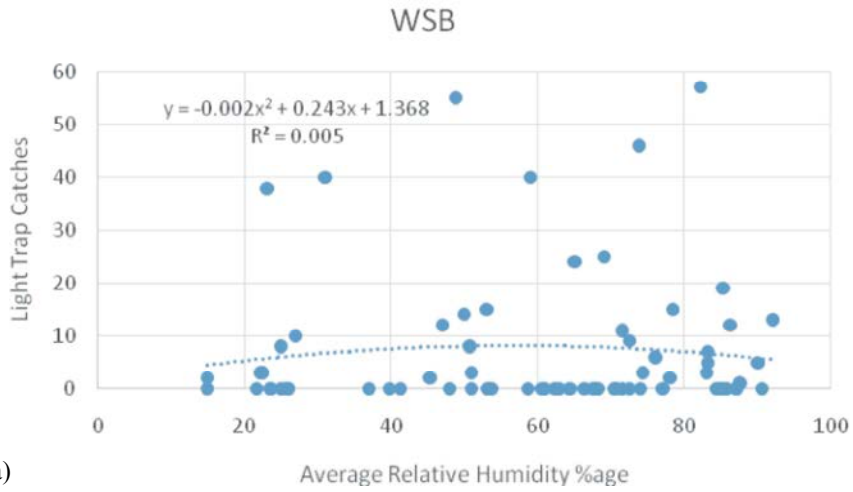


(e)

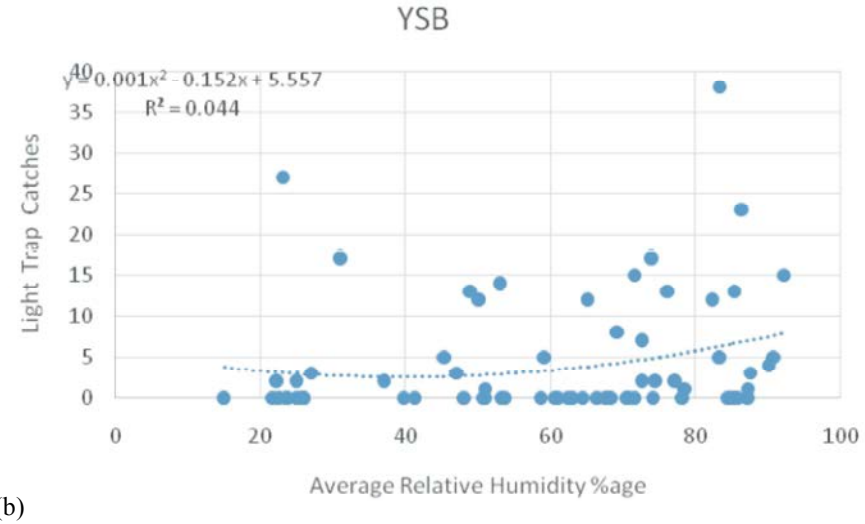


(f)

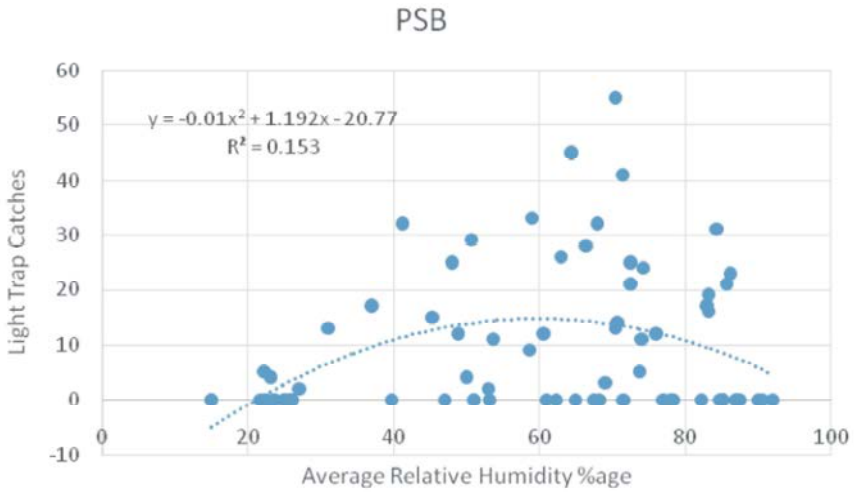
Fig. 2: Weekly Total Light Trap catches of White Stem Borer, Yellow Stem Borer and Pink Stem Borer and weekly Average Temperature at Kala Shah Kaku for the years, 2015 and 2016



(a)



(b)



(c)

Fig. 3: Weekly Total Light Trap catches of White Stem Borer, Yellow Stem Borer and Pink Stem Borer and weekly average Relative Humidity percentage at Kala Shah Kaku for the years, 2015 and 2016.

and YSB has no impunity to this thermal code [23] revealed minimum temperature and relative humidity to be important dynamics that influenced the YSB outbursts. As reliable forewarning and monitoring tools are indispensible for pest management, the YSB prediction model would prove useful in forewarning likely occurrence of the pest in Mandya region, thereby paving way for timely action and prevention of yield losses due to the pest.

CONCLUSION

Therefore, the knowledge and information of insect pest catches in light traps could be used for developing integrated pest management measures to safeguard the health of agriculture milieus. Present study, thus, withdraws scientific information on insect attraction to light trap under specific ecological circumstances of temperature and humidity. It also appears from the results that lower and upper temperature limits are significant climatic aspects responsible for insect flight and insect catch. Based on this information, the rice sowing and transplanting could be settled according to the climatic conditions to avoid insect pest attack and crop damages. Moreover, the other pest suppressing techniques could be kept in consideration in the light of these studies for the months favoring insect pest population.

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