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***Short Communication***

# Does Trash Burning Harm Arthropod Biodiversity in Sugarcane?

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## ABSTRACT

Sugarcane trash burning is a common practice among sugarcane growers of Pakistan. To assess its impacts on biodiversity of arthropods associated with sugarcane crop, a survey was conducted in four different locations of district Jhang, Pakistan. Burning of sugarcane trash significantly ($P<0.05$) lowered the abundance of sow bugs, spiders, ladybird beetles and ants i.e., 96%, 95%, 85% and 61%, respectively. Few arthropods remained unaffected i.e., field crickets, cockroaches, hairy caterpillars and ground beetles. The arthropods inside the stalk debris and stubbles (sugarcane borers) were not affected significantly by trash burning. It is concluded that trash burning in sugarcane does not support the ecosystem by destroying arthropod biodiversity (predators & scavengers) and is having no impact on sugarcane borers. © 2012 Friends Science Publishers

**Key Words:** Trash burning; Sugarcane; Biodiversity; Arthropods

## INTRODUCTION

Sugarcane is one of the important cash crops in Pakistan and plays a pivotal role in both agricultural and industrial economy of the country. Pakistan is the 5th largest sugar producer in the world (FAO, 2009). In Pakistan, sugarcane is cultivated over an area of 1241 thousand hectares and the production is estimated to be about 63920 metric tons with productivity of 51 tons per hectares (Anonymous, 2009).

Trash burring after sugarcane harvesting is very frequent practice in Pakistan. The main purpose of trash burning is to make ratoon keeping easier after harvesting. The complete trash burning to ash destroys some harmful diseases and insects and add small amount of potassium and phosphate to soil (Tan, 1995). There is an increasing concern with trash burning in developed countries on account of environmental pollution (Arbex *et al*., 2007), loss of soil fertility (Souza *et al*., 2012) and biodiversity (Srikanth *et al*., 1997).

On the other hand keeping the trash without burning is called trash mulching or trash farming (Mulkins, 2000). The trash mulching has been proved advantageous in conserving soil moisture (Tan, 1995), soil protection against erosion and nutrient leaching (Tan, 1995), controlling the weeds (Singh *et al*., 2002) and especially in increasing organic matter and nitrogen fixation by soil micro-organisms (Patriquin, 1982). Many sugarcane producing countries in the world have obtained higher yields with ratoon crops by application of trash mulching in the cane field after harvesting (Mulkins, 2000).

There is an increasing concern about biodiversity loss on account of deliberate fires in natural and agricultural ecosystems in the world. Sugarcane crop is one of such ecosystems, which are extensively burnt during pre and post-harvest stages. Arthropods can be very good ecological indicators to assess the impact of trash burning on biodiversity. Previously most of the work has been done on assessing the fire impacts on biodiversity in grassland (Ford, 2000; Parmenter *et al*., 2011) and forested ecosystems (Moretti *et al*., 2004), while little attention has been given to agro-ecosystems in this regard.

Since arthropods play a pivotal role in food web at any ecosystem, their destruction can threaten many bird, amphibian and reptile species. The current study was planned to investigate the impacts of trash burning in sugarcane fields on the underneath hiding biodiversity of arthropods and to assess whether trash burning can be advantageous to some extent by killing the larvae and pupae of sugarcane borers hibernating inside the cane debris.

## MATERIALS AND METHODS

The study was conducted in four different locations of district Jhang (31.306ºN & 72.328ºE), Pakistan i.e., sugarcane fields along Faisalabad, Gojra, Toba Tek Singh and Bhakhar Roads, within the range of 10 km from the main city. The climate of the area is subtropical with marked variations between summer and winter. The mean summer (April to September) temperature is 38.2ºC, while the mean winter (October to March) temperature is 4.5°C. The average annual rainfall is 180 mm.

A total of 60, one acre sugarcane plots were selected (15 in each location) with variety HSF-240. Two different

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sampling methods were adopted for the assessment of two types of biodiversity e.g., (i) biodiversity of above soil arthropods hidden underneath the trash and (ii) borer populations feeding inside the sugarcane stalk debris and stubbles. Data were recorded twice (one day before & 5 days after trash burning) from 1st February to 15th March, 2012.

For the assessment of arthropods hidden underneath the trash, a quadrate of one square meter was randomly thrown twice in an acre. All the arthropods inside the quadrate were counted. For the convince in work and avoiding taxonomic constraints, the arthropods were categorized into morphologically similar groups (morpho-groups) and closely related species or morpho-species were clustered in their respective morpho-group i.e., ants, spiders, ladybird beetles, ground beetles (predators), sow bugs, cockroaches (scavengers), hairy caterpillars and field crickets (phytophagous).

In the same plots, for the assessment of arthropod pests (borers), ten sugarcane stalk debris and ten stubbles in each acre were randomly selected. Stalk debris and stubbles were dissected longitudinally with the help of knife in search of any larva and pupa. The number of larvae and pupae of different borer specie were counted. The state of larvae i.e. dead or alive was also noticed.

The data regarding pre and post burning arthropod populations were subjected to paired sample comparison test (t-test at alpha=0.05). The borer populations were compared among the four locations with the help of one-way ANOVA and the means were compared with Tukey's test at 5% level of significance. Statistical analysis was performed on computer software XLSTAT (XLSTAT, 2012).

## RESULTS AND DISCUSSION

Sugarcane is a yearlong crop and provides an ideal micro-climate for grooming variety of arthropods (Ahmed *et al*., 2004). Kumarasinghe (1999) reported 103 arthropod species associated with sugarcane crop in Sri Lanka, while Ahmed *et al*. (2004) reported 117 insect species in 12 orders from a single district (Faisalabad) of Pakistan. We also observed lot of arthropod species but for the sake of ease in work and keeping the things simple, we distributed these species into larger morpho-groups. So our findings are more generalized rather than species specific.

The t-test (Alpha=0.05) results show that the ants, spiders, sowbugs and ladybird beetles were significantly affected by trash burning (Fig. 1). The population of spiders was strongly affected by trash burning followed by sow bugs, ants and lady bird beetles. On the other hand, there was no significant difference in pre and post trash burning populations of field crickets, cockroaches, hairy caterpillar and ground beetles. The latter two were least affected by trash burning.

Srikanth *et al.* (1997) rendered some preliminary efforts towards assessing the impact of sugarcane trash burning on spider populations in India. They found 13.5% reduction in spider populations, 24 h after trash burning. The results of current study also suggest significant reduction (95%) in spider population five days after trash burning.

A good knowledge of habitat utilization by different group of insects at local scale and regional scale are necessary to fully understand the effect of fire on native arthropods assemblage (Sackmann & Farji-Brener, 2006). For example, both the ants and the sowbugs live in soil. In this study, both the taxa were significantly affected by trash burning i.e., 61 and 96% population reduction, respectively. Sackmann and Farji-Brener (2006) found that ants richness was lower in the burnt than in unburnt plots in scrub but was the same in burnt and unburnt steppe plots. They concluded different habitat utilizations by different taxa as the main reason of such differences.

The population of ladybird beetles was also reduced by 85% after trash burning. Ladybird beetles are important biological control agents and can hibernate at forest edges, near isolated shrubs and in protected areas, insulated by leaf litter (Hodek & Honek, 1996). Their destruction on account of trash burning can result in sever imbalance of natural predator and prey relationships and ultimately pest out breaks especially in spring cereal aphids.

There was no significant difference in the stem hiding populations of borers (larvae & pupae) between pre and post trash burning treatments (t-test, $\alpha$= 0.05) (Fig. 2). No borers found dead on account of fire in post trash burning treatments.

There was no significant difference in the borer populations among the four locations (Fig. 3). It can be generalized that there was an equal distribution of four borer species in all the four distant locations of Jhang i.e., at least 5 km from each other. It is believed that trash burning has negative effects on natural enemies while borers larvae are less effected (Rochat *et al*., 2011). This is perhaps the reason that when burning was banned, borer infestation was decreased due to increased natural enemy populations (Rochat *et al*., 2011). Cota *et al*. (2009) did in depth study on *Diatraea considerate* (stem borer) response towards trash burning. They concluded that although borer survived inside the stalk but adult emergence was nil. They also concluded that these are the burnt underground stalks most of which contribute to the abundance of borers in ratoon crop. Tan (1995) found that it is the intensity of burning which determines the emergence of borers. The complete burning to ash will surely destroy all kinds of pests. There is a need to further evaluate the tolerance of different borer species towards trash burning.

In conclusion, the rash burning in sugarcane does not support the ecosystem by destroying arthropod biodiversity (predators & scavengers) and is having no impact on sugarcane borers. Keeping in view the environmental pollution, soil fertility and biodiversity loss, future studies

**Fig. 1: Results of the paired sample t-test for comparing arthropod populations in pre and post trash burnt plots. Error bars show standard errors (Pr.B=Pre-burnt; Po.B=Post-burnt; LBB=Lady Bird Beetles)**

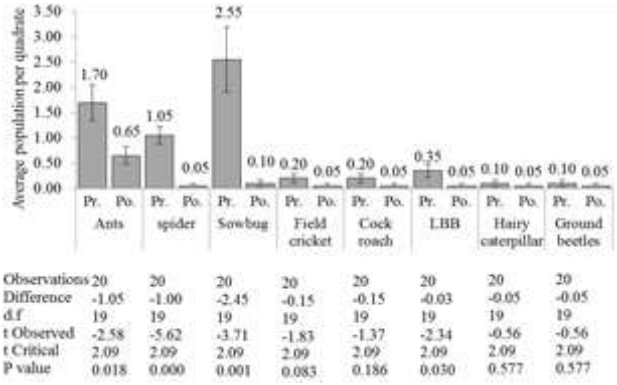



**Fig. 2: Results of the paired sample t-test for comparing sugarcane borers in pre and post trash burnt plots. Error bars show standard errors (Pr.B=Pre-burnt; Po.B=Post-burnt)**

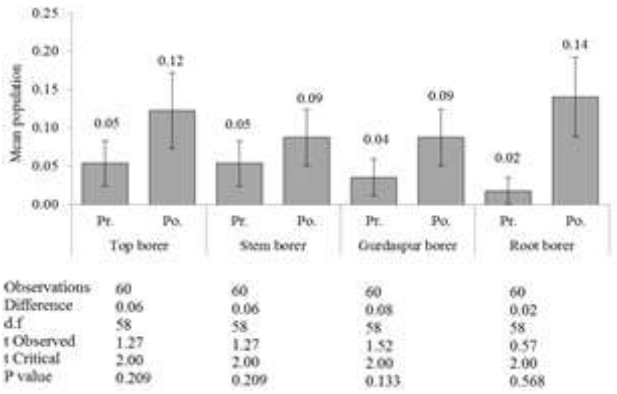
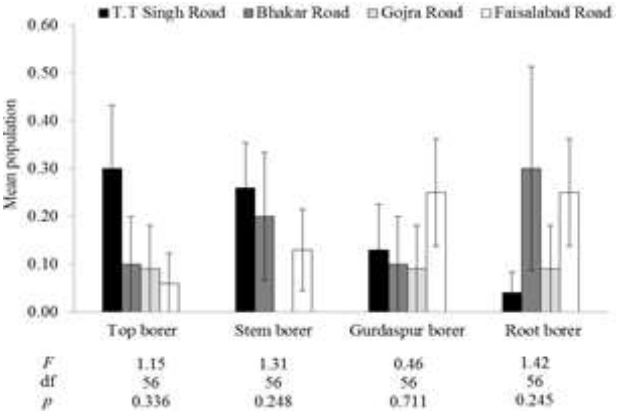



**Fig. 3: Comparison of means of different borer populations among four locations at District Jhang. ANOVA results for each borer population are given under their respective bars at α = 0.05. Error bars show standard errors**




should focus on some alternative of trash burning e.g., trash farming (removing trash three months before harvesting) (Mulkins, 2000), mixing trash with bagasse for electricity generation (Ripoli *et al*., 2000) and early decomposition of trash with the help of effective microbes (Ashraf *et al*., 2007).

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