Protection of stored rice and maize against insect pests in rural communities in the Tshopo province, DRC, using ethnobotanical species *Scorodophleous zenkeri* and *Tetrapleura tetraptera*

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BACKGROUND

Postharvest losses of rice and maize due to insect pests remain a challenge for rural communities in the Tshopo province in DRC. Smallholder farmers in the region rely strongly on these cereals for food security and income. Yet, significant losses occur during storage, primarly due to infestation by weevils and grain moths.These pests not only reduce the quantity of stored grains but also compromise seed quality and germination power, directly impacting farmers' livelihoods. Recently, there is a growing interest in alternative, affordable, and environmentally friendly pest control strategies, particularly those based on local knowledge and resources. Recent research and floristic inventories in the region have identified two tree species with high potential for valorization as botanical protectants: Scorodophloeus zenkeri and Tetrapleura tetraptera.

Describing the efficiency of these ethnobotanical species offers a promising, sustainable approach for the protection of stored rice and maize in rural Tshopo, with the potential to reduce post-harvest losses, improve food security, and support the resilience of local farming communities.

HYPOTHESIS & AIMS

In this research, we aim to evaluate the capacity of cereal protection through utilization of two ethnobotanicals against insect infestation during storage.

Therefore our main hypotheses are :

Stored cereals treated with ethnobotanicals suffer from less mass losses and germination rate losses that untreated cereals.

Population of rice and maize weevils in treated cereals are inferior to population of rice and maize weevils in untreated grains.

Ethnobotanicals reduce the oviposition rate of rice and maize weevils in stored cereals and can potentially act as repellents.

METHODS

Twenty sampling sites were designated in domestic storage facilities throughout the Tshopo province, DRC. Modalities tested were traditional storage; PICS bag; PICS bag with 2% S. zenkeri, PICS bag with 2% T. tetraptera and finally 2% of half and half mixture of both ethnobotanicals. The storage sites were monitored on day 0, 30 and 60. Total weight loss is monitored using gravimetric analysis. Germinaiton rate is determined using n=3x100 grains and emergencence of roots is observed after 7 days. All samples are sieved using 0,5x0,5 cm and 0,3x0,3 cm granulometry, emerged insects in the grains are colleted in 70% EtOH (v/v) and identified using binoculars and reference identification keys. Effects on ovipositon behaviour was done using the acid fuchsin essay using powdered ethnobotanicals at 1, 3 and 9% (m/m). Repulsivity was done using an adapted "Y" olfactometer essay. A concentration of 3% (m/m) was used for 10 min and a total airflow of 2L.

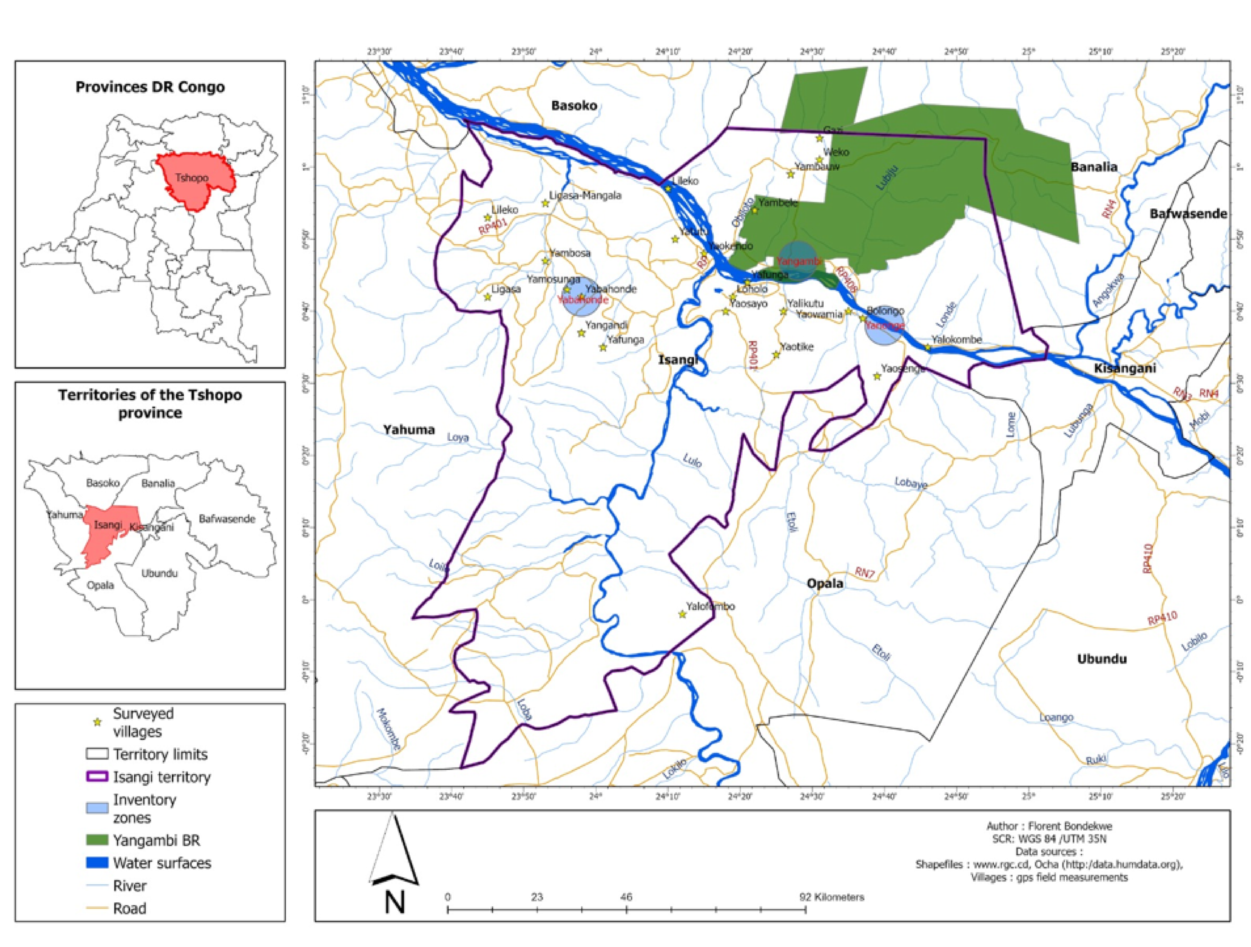

FIG.1 Map of study area and sampling sites, Tshopo province, DRC.

RESULTS

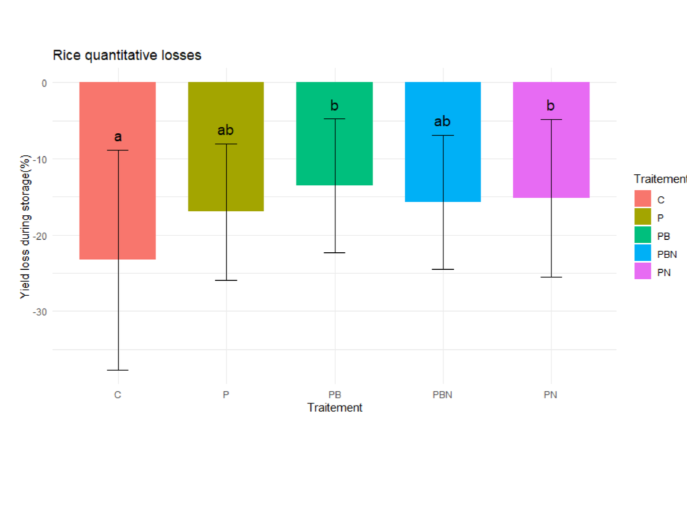

FIG 2: Rice weight loss in storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

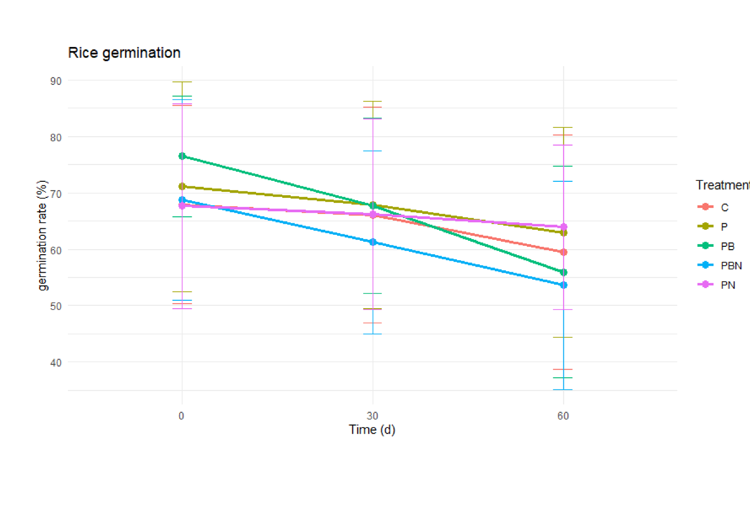

FIG 3: Rice germination rate in storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

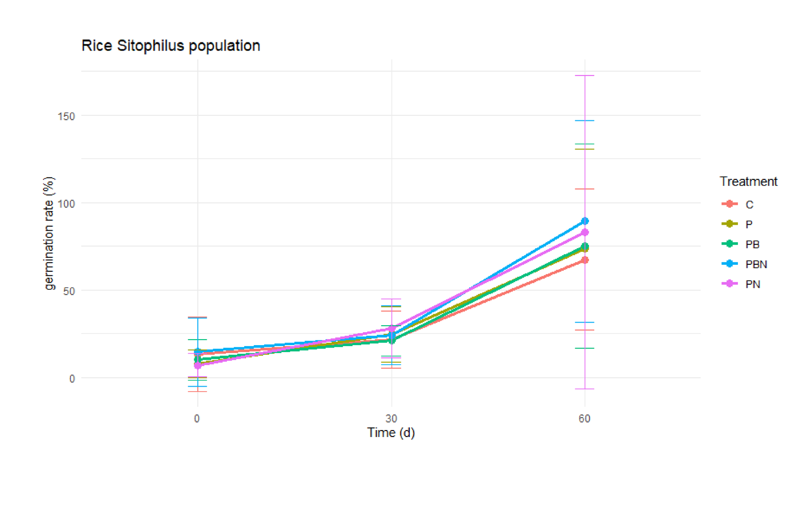

FIG 4: *Sitophilus sp.* population in rice storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

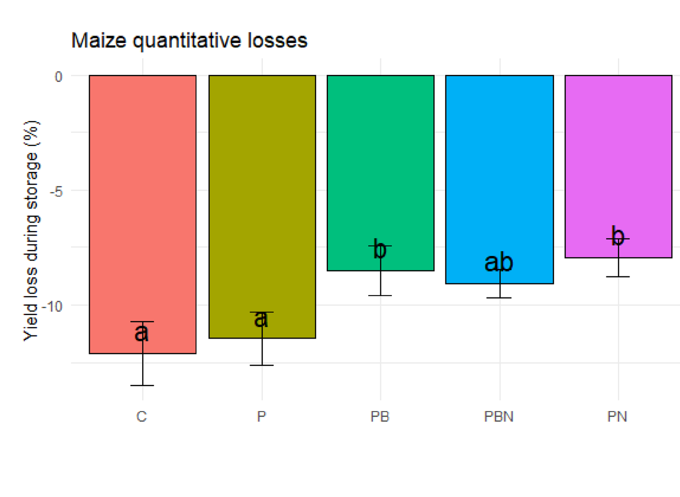

FIG 5: Maize weight loss in storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

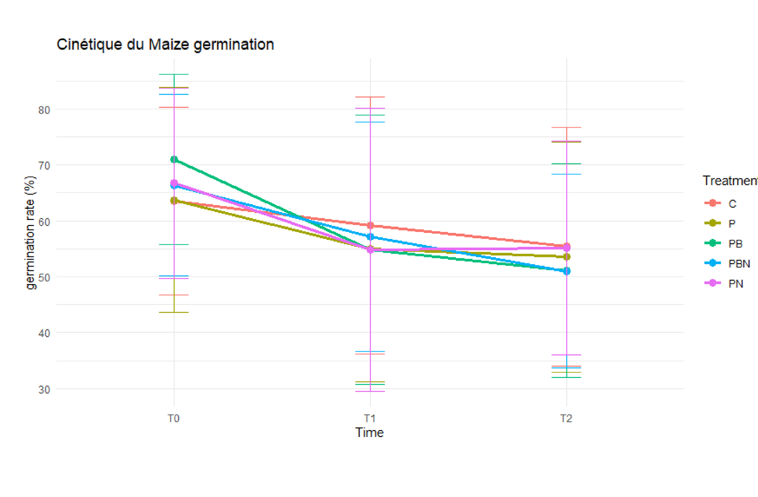

FIG 6: Maize germination rate in storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

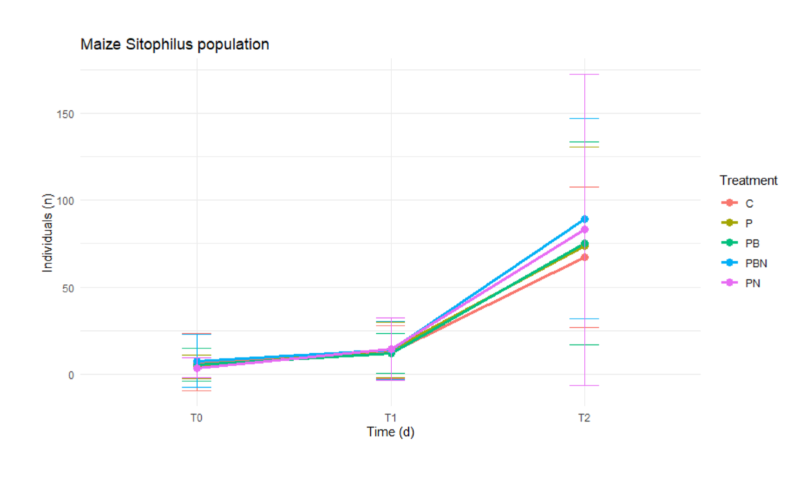

FIG 7: *Sitophilus sp.* population in maize storage units during 2 month of monitoring. C for Control; P for PICS; PB3 for PICS and S. zenkeri; PBN3 for PICS, S.zenkeri and T. tetraptera; PN3 for PICS and T. tetraptera.

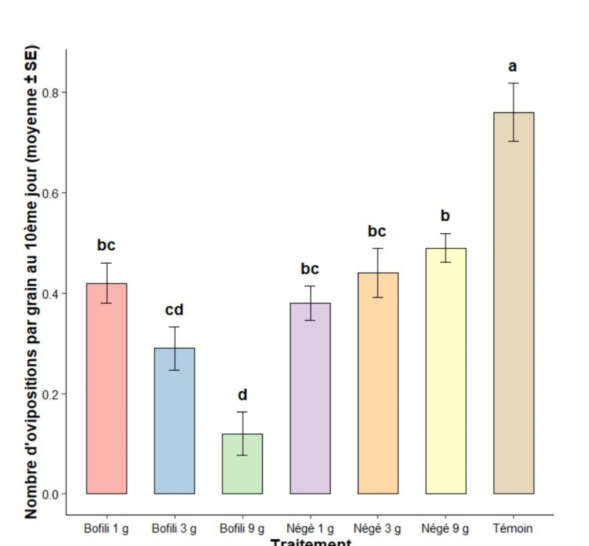

FIG.8 Average number of ovipostions per grain in stored grain treated with 0, 1, 3, 9% (m/m) etnobotanicals using acid fuchsin essay.

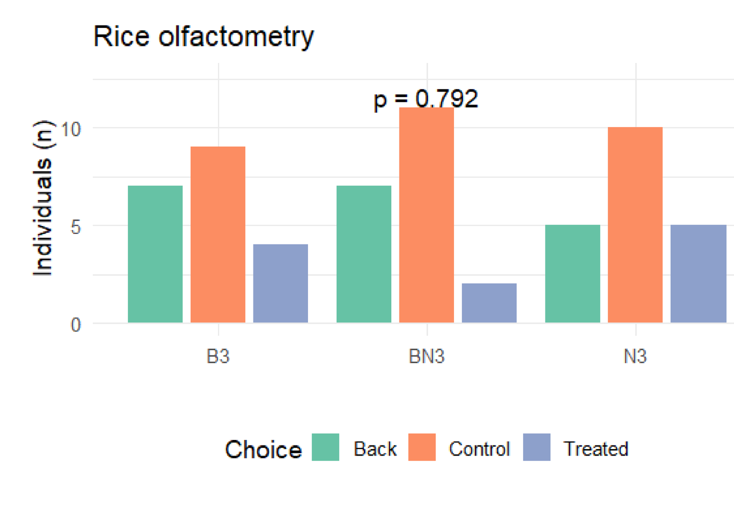

FIG.9 Contingency of choices during olfactometry essay in rice using 3% (m/m) ethnobotanicals.

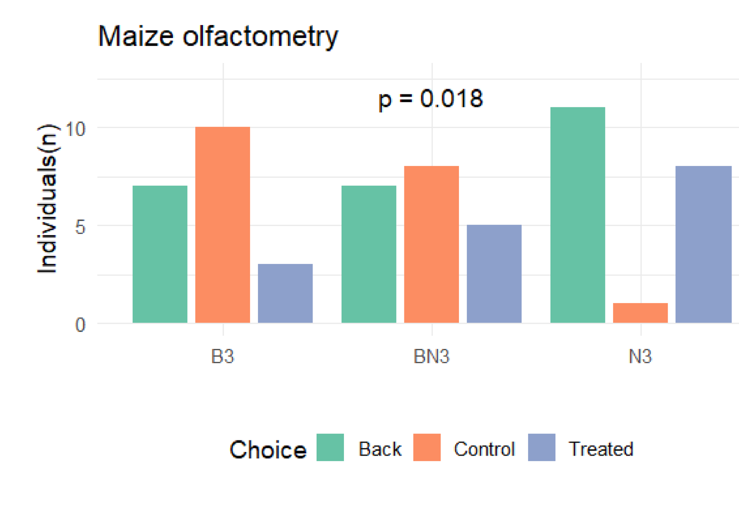

FIG.10 Contingency of choices during olfactometry essay in maize using 3% (m/m) ethnobotanicals.

DISCUSSION & FUTURE DIRECTIONS

The treatment of rice and maize with S. zenkeri and T. tetraptera has a signifiant effect on the quantative losses endured by the stored goods during 2 months. Both germination rates and weevils population are not altered by the different ethnobotanical treatments. Both plants induce a reduction of ovipositions in stored grains, especially S. zenkeri. Volatile compounds emitted by ethnobotanicals are the main driver of the choice of *Sitophilus zeamais* during olfactometry essais when tested on maize. Conversly, compounds emitted during the essais on rice are not the main choice driver. Those results show that the two tested plants are perturbators to the feeding, reproductive and to some extend the food foraging behaviour of *Sitophilus zeamais* , the main iinsect pest observed in the region's storage units.

Future prospects need to evaluate the toxicity of these ethnobotanicals against both the insect pests and to the stored cereals. Moreover the description of the mode of action of those plants against insect pests are crutial for further optimisation, formulation and upscaling of the potential bio-based solutions.

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