



# **Farmers' Indigenous Knowledge Practice for Crop Protection: A Case Study of Ant Protection on Teff (*Eragrostis teff*) Crop in North Wollo, Ethiopia**

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## **Author's contribution**

*The sole author designed, analysed, interpreted and prepared the manuscript.*

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## **ABSTRACT**

The study was conducted under selective Kebeles in Kobo district of North Wollo Zone in the North eastern part of Amhara Regional State, Ethiopia. Although farmers have imperative experience with indigenous knowledge to reduce and eliminate the effect of ant over teff crop, there is no any research document reported with this regard. Thus, the aim of this research is to explore farmers' indigenous knowledge on ant protection on teff crop. To do so, descriptive research design was adopted. From 400 farmers in selected kebeles, a total of 200 household farmers in five kebeles, 40 in each, were selected using purposive sampling techniques. In-depth interview with their culture, custom and in comfort and survey were used to collect both quantitative and qualitative data. Then, the quantitative data were analyzed using IBM SPSS and the qualitative information was also summarized properly. Based on the analyzed data, the highest percentage of respondents (44.5%) were between the ages of 30-50 years while the lowest percentage (24%) of respondents found below the age of 30 years and the remaining percentage were above the age of 50. According to the interviewed data and survey results, farmers have used DDT (98%), ash (82%), herbal mulching (100%), burning on nest (38%), damping nest (64%). In general, this research tried to reveal the non chemical methods of indigenous knowledge used in the protection of teff crop. So that, it is better to investigate the chemical nature and the adverse effect of the above mentioned plant species on ant and need to scale up into industrial production.

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## 1. INTRODUCTION

*Teff* [*Eragrostis teff* (Zucc.) Trotter] is a tropical cereal crop belonging to the family of Poaceae, subfamily Eragrostoidae, tribe Eragrosteae, and genus *Eragrostis*. The main center of origin and diversification of *Teff* is Ethiopia and almost all of which are consumed in the country [1] and it is endemic to Ethiopia [2]. There are various types *teff* varieties locally named as *Nechi teff* (*magna*), *Key teff*, *Bunign*, *Tikurie* and *Sergegna*.

The national productivity of *teff* in Ethiopia is about 15.75 qt/ha. In Amhara Region from the total cereal cropping area, *teff* accounts 34.13% and in terms of production it accounts 25.54%. In addition, 61.9% of farmers are producing *teff* in the region and the productivity of *teff* is 15.83 qt/ha. In North Wollo Zone from the total area of cereal crops *teff* accounts 31.6% and in terms of production, it accounts 27.6%. The Zonal average productivity of *teff* is 13.92 qt/ha [3]. According to the RKDOA [4] report, from the total cultivated land for *teff* production in North Wollo Zone, Raya Kobo district accounts 22.55%, from the total area of crop cultivation in the District *teff* accounts 30.5% and the productivity is 14 qt/ha.

*Teff* is superior to other grains in terms of some nutritional values and composition. Various *teff*-based food products have been developed, the majority of which being gluten free. These include injera, pasta, bread, sourdough, cookie, extrudate, fat replacer, weaning food, malt, and lactic acid beverage [5]. As it indicated in FAO [6], *teff* forms the staple diet of many Ethiopians as the flour is used to make injera and unleavened bread, but it is a very delicate and fragile crop that requires a lot of work and care, and it has one of the lowest yields of the cereal crops.

Compared to other cereal crops, *teff* is a low-risk crop to drought and has become a highly preferred product by Ethiopian farmers because it is resistant to adverse weather conditions and feeds with rain [7]. This is true if only if due to its early maturity. However, it is very susceptible to some biological factors including insects and weeds. For instance, it is highly affecting by various types of grasshoppers on a very young seedling stage and ants cut the heading starting from seed setting stage. According to Kebebew et al. [8], biotic stresses such as diseases, weeds and insect pests are among the constraints and

as Yumbya et al. [9] technical report, the farmers had lost their *teff* yield due to pests. Without any measurement, those groups of insects can eliminate the whole cultivation and the farmers have suffered with crop failures due to the severity. Consequently, the farmers use their own indigenous knowledge and skill to reduce the harmful effect of ants on their *teff* crops. Indigenous knowledge is a systematic body of knowledge acquired by local people through accumulation of experience, informal experiment, and understanding of their environment [10] and it is ecological knowledge [11]. Although it is imperative experience, there is no any research publication document reported with regards to the exploration of farmers' indigenous knowledge of crop protection in kobo district of North Wollo.

Therefore, it is essential to look at and explore farmers' indigenous knowledge for how they can wipe out the ants on their *teff* farm. Besides, this research is important to scale up the skill using advanced science and technology and share such helpful experiences to other production areas. Hence, the objective of this research is to explore farmers' indigenous knowledge over effect of ant on matured *teff* crop in North Wollo, Ethiopia.

## 2. LITERATURE REVIEW

*Teff* is an allotetraploid cereal crop grown primarily in Ethiopia. It is traditionally harvested crop in Ethiopia, where it was first domesticated between 1000–4000 BC even before the ancient introduction of other crops [12]. It is entirely cultivated in Ethiopia and Eritrea as food crop and distributed to several other countries and grown on a limited basis a grass for livestock forage in Australia, India, Kenya and South Africa [13]. *Teff* has also been grown on several places in the Netherlands and is becoming an important health crop [14].

It is highly adapted to different agro-ecological zones and grows on diverse soil types, under relatively wide-ranging climatic conditions and can survive reasonable levels of water stress and water logging [6]. It is widely grown from sea level up to 2800 m above sea level [2] and with an annual rainfall of 750-850 mm, a temperature ranges of 10-27°C. However, it can also grow in much more varied areas with rainfall up to 1200 mm. The optimum length of growing period ranges from 80 to 130 days [15].

In most parts of Ethiopia, *teff* is usually sown during the main summer rainy season between July and August. Seeds are broadcasted on a well ploughed soil and lightly covered with soil [8]. The sowing period of the crop is different from location to location on which wet sowing is preferred to avoid false start to improve seedling establishment [16]. Farmers broadcast seeds in a scattered way by hand at high seed rates and this hampers *teff* yields [17]. Technologies such as row planting and transplanting, where the seed rate is reduced and more space between seedlings is given, are assumed to be superior to broadcasting because they allow for weeding and diminish competition between seedlings [18].

There are different types of insects that affect *teff* production in the study area. These are shoot fly, *teff* grasshopper, *teff* red worm and ant. These insects are common in the study area during early stage of *teff* growth and before the start of heading. The farmers use seed rates above the recommended level in order to compensate for high incidence of insects at the early stage of *teff* plants [19]. The farmers produce crops through indigenous knowledge of environmental conditions and seasonal change without access to external inputs, capital, and modern scientific knowledge [20].

*Teff* is a staple food crop for most households in rural and urban areas in Ethiopia. It is primarily grown to prepare *Injera*, bread, and some native alcoholic drinks [21]. It is more eagerly eaten by urban households than by rural households. The lower consumption by the poor is also partly due to the high prices of *teff* which is typically twice as high as the cheapest cereal that was maize [22].

### 3. MATERIALS AND METHODS

#### 3.1 Description of the Study Area

The study was conducted under selective Kebeles in Kobo district of North Wollo Zone in the North eastern part of Amhara Regional State, Ethiopia. It lies between 11°54' 04" and 12°20' 56" N latitude and between 39°25' 56" and 39°49' 04"E longitude with an elevation of 1400-3100 m above sea level [23]. The area is characterized with bimodal rainfall (*Meher and Belg seasons*), 19-33°C mean minimum and maximum Temperatures respectively and has mixed agriculture. It covers the bulk of Amharic speaking population.

Farming activities in the area are principally dominated by smallholder farmers who mostly grow cereals (sorghum (*Sorghum bicolor* (L.), *teff* (*Eragrostis tef*), maize (*Zea mays*) and rarely millet (*Pennisetum glaucum*); legumes (pea (*Pisum sativum*), faba bean (*Vicia faba*), chickpea (*Cicer arietinum*), lentil (*Lens culinaris*)); oil crops (linseed (*Linum usitatissimum*), sesame (*Sesamum indicum*), noug (*Guizotia abyssinica*)). A considerable amount of farmers keep livestock such as cattle, goat, sheep and others.

#### 3.2 Sampling Design

In this study, descriptive research design was adopted because it enables to collect large quantity of in-depth information about the farmers' regard to their indigenous knowledge of crop protection in case of effect on *teff* crop. The total number of farmers (400) in the selected Kebeles were considered as target population and non probability /purposive/ sampling technique was used to select farmers who gave responses based on the interviews. Among several approaches, Yemane [24] was used to determine the sample size. Therefore, the simplified formula  $n = \frac{N}{1+N(e^2)}$  was used with sampling error should be only 5%.

Where N = Population size, n = sample size and e = an error. Hence,

$$n = \frac{400}{1+400(0.05^2)} = 200$$

So that, a total of 200 household farmers in five Kebeles, 40 farmers in each, were selected and interviewed to collect primary data. The interview was done in accordance with their culture, custom, in comfort and the necessity was defined very well through direct interaction with the participants.

#### 3.3 Data Collection and Analysis

All the valuable data were collected from 02 September to 28 December, 2018 using various restricted and open ended questions to allow the respondents to speak their perceptions without restrictions and to include ideas that might not indicate in the interview in the inspection of indigenous knowledge. Both qualitative and quantitative data were collected via in-depth interviews and survey. After having necessary data from respondents, they were grouped,

coded and tabulated. Then, were subjected to basic descriptive analysis using IBM SPSS, version 21. Besides, the qualitative information was summarized properly.

## 4. RESULTS AND DISCUSSION

### 4.1 Background of Respondents

Out of the total interviewed farmers, the highest percentage (44.5%) were between the ages of 30-50 years that actively participated in farming while the lowest percentage (24%) of respondents found below the age of 30 years and the rest (31.5%) were found above the age of 50 years. As it indicated in study of Tegegne et al. [25], the mean production age in Kobo district was 46.9 years. With regards to gender, 124 which is 62 percent are males while females accounted for 38 percent out of the total respondents. Almost all of the farmers interviewed had no formal education. In general, there were no significant different among interviewed farmers with respect to educational background and skills in farming. This suggested that the presence of homogeneity among the participants in practicing indigenous knowledge in the target area.

### 4.2 Effect of Ant on *Teff* Yield

According to 94% of respondents, there were failure of both grain and biomass (straw) yield of their *teff* if there were no any protection. As it observed during survey, the ants cut *teff* heading starting from its seed setting stage. As it stated in the study of Gras et al. [26], some species of ant can damage crops and some other can damage wooden structures. Despite these negative impacts on vegetation, the ants play an important role in many plant life cycles. Ants turn and aerate the soil in which the plants grow, and some ants are known to help disperse plant seeds [27]. Besides, people said that in the ancient time "*teff seed was found in the ant nest where there was no in any other place due to the presence of prolonged drought*" (Oral presentation).

### 4.3 Farmers' Indigenous Knowledge over Ant on *Teff* Crop

As majority of selected farmers (97.5%) signified that the presence of useful skills and experiences which used to reduce the effect of ant on matured *teff* in the examined Kebeles. Those methods have grouped into chemical and

mechanical means of protection. The following practices have been used frequently by farmers to reduce the effect of ant on matured *teff* heading (Fig. 1).

### 4.4 Protection Using DDT

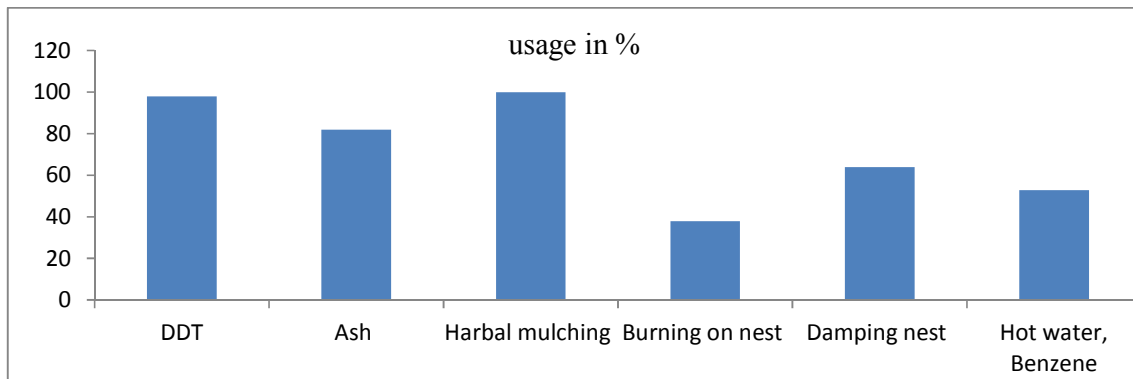
Almost all of the respondents (98%) reflected as they used DDT (Dichloro diphenyl trichloroethane) together with a mixture of roughly crashed cereal crops with 2 to 1 ratio of crashed grain and DDT respectively. Practically, they scattered around the nest and on the way of their road. The DDT bind to the crashed grain killed the most active worker ants following they need to take grain. According to the report of UNEP [28] DDT as chemical agent was designed to destroy insects, weed, rodents, fungi and other human annoyance trouble. Besides Thieu [29] added that DDT was the most popular and effective pesticide to help people combat unwanted organisms and gain dramatically improvement in agriculture. On the other hand, some scholars [30,31] stated that using DDT would not advisable since it might kill birds, soil microorganisms and contaminated water bodies. In general, negative impacts of DDT on the environment and human health were acknowledged and disseminated widely to warn population and prevent unexpected situations occur [29].

### 4.5 Protection by Damping the Nest

According to the farmers (64%) in the selected districts, damp the nest by moisten the soil around and therefore block the opening of the nest during early morning when the ants exist inside. As it observed, the strength of damping is varied and so that the blocking efficiency of ants varied one to the other. After 2-3 weeks, the ants formed a new nest opening nearby. However, the crop harvested while there was repeated damping.

### 4.6 Protection through Ash

Farmers spread the ash (locally *Amed*, traditionally made fire place for cooking food) around the ant nest and path. According to respondents (82%) and survey data, this is the most frequent practice in their farm especially nearby to the residence. This might be due to the ash was produce from burning of various plant species and other organic matters such as dung and used for the protection of ants. Similarly, Lal and Verma [32] reported that ash act as detergent and it is simple and easy to apply,



**Fig. 1. Indigenous practices as a means of ant protection over teff crop heading**

effective method for insect pest, eco-friendly and has no side effects. According to Okutu et al. [33], the use of wood ash was observed to keep the incidence of crop damage low and as it kept the insect pest attack. Salako [34] generalized using ash is rekindling a renewed interest in the use of natural products from higher plants in the pest and disease management scheme in agriculture.

#### 4.7 Protection Via Various Plant Species

Among farmers interviewed, all of the them (100%) mulched various young plant species on the ant nest using stone or any other loading material over it. Among those plant species the leaves of Aleo species and stem plus leaves of *Kimitita* (*Cissus quadrangulari*), were the main and the most effective plants to reduce adverse effect of ants. As it observed, each of the plant's branch together with the leaf were wounded on the nest and the bleeding chemical and/or the odor might disturb the ants so that they eradicated from the place. Furthermore, Dhale [35] stated that the advantages of botanical pesticides lie in their rapid degradation and lack of persistence and bioaccumulation in the environment, which have been major problems in synthetic use. In addition to mulching various plant species, some farmers (38%) indicated that as they burning crop residues or any other plant on the ant nest, but burning of various plants or any other is not advisable since it may kill other soil organisms.

#### 4.8 Protection via Hot Water, Benzene/Nafta Application

Some of the farmers (53%) in the selected Kebeles have poured a very hot water into the ant nest. It is obvious that the hotness of water killed the ants in the nest. As Tschinkela and Kin

[36] stated that hot water is an extremely effective and specific killing agent for ant colonies. Similarly, some peoples also sprinkling Benzene /Nafta in and around the nest and the ants released away and killed. This might be due to the chemical itself and odor of Benzene/Nafta affects the ants.

### 5. CONCLUSION AND RECOMMENDATION

Subsistence farming through crop plants is rapidly disappearing might due to major insect pest and disease attack. The ant attack over teff crop on its seed setting stage is one of the disappearing and yield reduction adverse effect of ant. In order to reduce and eliminate the effect, the farmers use various self developed means of protection. As the study result showed that farmers use various plant species as herbal medicine, wood ash, hot water, benzene/Nafta, soil damping and DDT. Among those means, using various herbs including *Cissus quadrangulari* and Aleo species are the first and the foremost method over the adverse effect of ants. Such plant species are effective to avoid the ant through direct contact. Besides to mulching, some farmers burning crop residues or any other plant on the ant nest. In general, this research bring out the non chemical methods of indigenous knowledge used in the protection of teff crop. To this end, it is recommended to investigate the chemical nature and the adverse effect of the above mentioned plant species on ant and need to scale up into industrial production.

### CONSENT

As per international standard written participant consent has been collected and preserved by the authors.

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## COMPETING INTERESTS

Author has declared that no competing interests exist.

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