

Demonstration of Disease Management Practices and Irrigation Scheduling on Onion Production for Pastoralists and agropastoralists at Enchete Kebele in Benna-Tsemay Woreda, South Omo Zone, Ethiopia

Review Article

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Abstract

The demonstration was conducted to evaluate and demonstrate the recommended fungicides and irrigation scheduling for diseases management and increasing yield of onion. A total of 25 pastoral and agro-pastorals were selected based on their interest and commitment towards the technology, model farmers, managing the experiment and have appropriate land for the demonstration. Both theoretical and practical training were given for them mainly focused on proper preparation of land, Irrigation scheduling, Diseases identification based symptoms, time of disease appearance, fungicide and proper application methods. Treatments: T1 = fungicide (Mancozeb) + 25mm/5 days irrigation water, T2 = fungicide (Mancozeb) untreated (control) + irrigation water and T3 = Agropastoral practices were demonstrated for yield and disease intensity. The results shows that the highest bulb yield (295q/ha) and the lowest average severity of purple blotch and stemphylium blight (24% and 27.67%), respectively were observed on plots with fungicide (mancozeb) + 25mm/5days irrigation water when compared with farmers practice and untreated control. During the field visit, pastorals and agro pastorals expressed as they were interested and happy with the demonstrated nafis variety along with recommended fungicide (mancozeb) and irrigation scheduling (25mm/5days) for its resulting highest bulb yield, marketable bulb yield, and low disease severity and highest net of return. Therefore, offices of agriculture needs to provide technical support to them on irrigation schedule, diseases symptom, time of diseases appearance and proper fungicide application method through different educational and extension method to manage the diseases and water use to maximize yield and net return.

Keywords

Demonstration; Fungicide; Irrigation scheduling; Disease; Onion; Preference

Introduction

Onion (*Allium cepa*) is one of the most popular vegetable crops all over the world. In Ethiopia, onion is one of the most important vegetables produced by smallholder farmers mainly as a source of cash income and for local consumption as flavouring the local stew 'wot'. In SNNP Region the area coverage and production were about 1, 681.51 ha and 17,367.42 tons, respectively with

the average yields 10.3t ha⁻¹ [1]. The crop is believed to be more intensively produced and consumed than any other vegetable crop

There are many factors contributing to low yield of onion, of which improper irrigation and diseases such as purple blotch (*Alternaria porri*) and stemphylium blight (*Stemphylium vesicarium*) are the major ones. In low land areas of Ethiopia, where, very erratic and recurrent

drought purple blotch and stemphylium blight are occurs very frequently cause the problem. Both pathogens cause similar symptoms and are managed in the same way. Early symptoms include small brown elliptical spots on leaves, which enlarge over time and may result in brown, necrotic streaks. When *Alternaria* is the causal agent, the brown lesions will eventually turn purple as fungal spores develop. Lesions caused by *Stemphylium* often appear dark brown to black from the production of dense masses of spores. They are responsible for causing severe yield losses ranging from 2.5% to 97% in both the bulb and seed crop [2-4].

Irrigation and disease interaction have a major impact on onion yields and production costs. Irrigation is the process of supplying controlled amount of water to help agricultural crop growth in areas with inadequate rainfall. It requires a relatively high investment in equipment, fuel, maintenance and labor, but offers a significant potential for increasing net farm income. Misuse of over irrigation during prolonged periods causes canopy saturation which is favourable for the diseases development. In addition, insufficiency irrigation water cause increasing competition for water use and make the crop stressed and susceptible to pest and diseases problem. Chronic droughts, water scarcity, competition for water use by inhabitants, inefficient on-farm irrigation management reduce water resource availability for irrigated agriculture [5].

Proper management practices, especially emphasizing on irrigation that use of suitable techniques and practices that deliver a more accurate supply of water to crops in right amount at the right time and disease management are important for most efficient use of water and to optimize production. The efficacy of some fungicides against purple blotch has been reported [6-9], Efficacy of combined fungicide and irrigation interval has reduced the disease severity and increase onion yield [10]. The yield of onion can be increased by proper management practices, especially emphasizing on integration of tolerant variety, irrigation scheduling and fungicidal disease management. In South Omo Zone, irrigation scheduling and fungicide efficacy study were conducted and 5.2ETc/day or 5mm water per day or 25mm/5days irrigation schedule and mancozeb fungicide were recommended for increasing onion crop production in this area. However, these improved technologies did not reach many farmers due to lack of awareness about technologies, unavailability and lack of access to improved onion seed/variety, inadequate information onion diseases management and lack of awareness on irrigation scheduling. In addition Low land livelihood Resilience Project (LLRP) survey report confirms gaps on demonstration of new methods (proper irrigation scheduling and diseases management practices) were sorted out as major constraints in the targeted area through discussing with pastoral and Agro-

pastoral groups (PAPREGs). In order to overcome the problem, the present study was undertaken to evaluate and demonstrate recommended irrigation scheduling and recommended fungicides for onion disease management with the following objectives.

1. To demonstrate diseases controlling fungicides on improved onion crop
2. To demonstrate irrigation scheduling on improved onion crop
3. To improve Pastorals and agro-pastoralist's knowledge and skill on onion production

Material and Methods

The demonstration was conducted in Benna-tsemay woreda, South Omozone, Ethiopia for one year (2021/2022). A total of 25 PAPREGS (15 male and 10 female) were selected based on their interest and commitment towards the technology, model farmers, managing the experiment and have appropriate land for the demonstration. A Seed of onion variety (Nafis) was obtained from market and raised following recommended nursery management practices. 3 or 4 leaves stage seedlings were transplanted to the demonstration field when estimated around 12 to 15 cm height on ridges of the furrow spacing of 50 and 20 cm between furrows and rows on the ridge, respectively. Fertilizer was applied as recommended. 100kg/ha of NPSB was applied at transplanting and 150 kg/ha of urea in split, half at transplanting and the remaining half of urea applied at 45 days after transplanting. Technology of Irrigation scheduling and chemical fungicides treatments: T1 = Chemical fungicide (Mancozeb) + application of 25mm/5 days irrigation water, T2 = Chemical fungicide (Mancozeb) untreated (control) + application of 25mm/5 days irrigation water and T3 = Agro pastoral practices were demonstrated and evaluated. Environmental and personal safety guard measures were used during pesticide application. Yield and disease data were collected. Disease data was collected throughout the demonstration period. The disease intensity for purple blotch and Stemphylium blight is rated using 0-5 scale [2] Based on numerical ratings/scale observed, Percent Disease Intensity (PDI) was worked out applying the formula given by [11].

$$PDI: \frac{\text{Total sum of numerical rating Numerical}}{\text{number of observation} \times \text{Maximum disease rating in the scale}} \times 100$$

Capacity building training and essential advice has been given to demonstration host pastoral and agro-pastorals (PAPREGs) from respective researchers and agricultural experts. During each visit, discussions were made with the agro-pastorals (PAPREGs) and DAs right on the demonstration plot to jointly evaluate the effectiveness of irrigation scheduling with farmer practice and fungicides

compared to control on the field. Field day was prepared other relevant stakeholders (non-PAPREG member, woreda expert, DAs, LLRP coordinator) were invited to visit trial sites) to share experiences and their preferences on the demonstrated technology. Both quantitative and qualitative data were collected, analysed and presented in graph and table form.

Table 1: Actors of the demonstration trial and their responsibilities

Actors	Expected roles
Interdisciplinary Researcher	Coordinating trial activity, preparation of training manual, facilitating of training, facilitating of field visit and workshop, data record, report writing.
PAPREG members	Providing of trial land, field management such as weeding, watering and pesticide spraying etc, participating on training and field visit. Keeping trial from any predatory, participating in focus group discussion.
DA expert (extension workers)	Field monitoring, data recording, field work reporting, coordinating PAPREG members.
LLRP coordinator	Financing and development partner

Economic Analysis

Cost of cultivation: Cost of cultivation was calculated on the basis of local charges for different agro inputs such as labour, fertilizers and pesticides.

Gross return: Economic yield were converted to gross return (ETB/ha) on the basis of local market prices of onion.

Net return: was calculated by deducting the cost of cultivation from the gross return.

B: C ratio: was calculated dividing gross return by cost of cultivation.

Results and Discussion

Effect of Irrigation Scheduling and fungicide on present disease severity control

The results (Figure 1) shows that use of recommended irrigation scheduling and fungicide reduced the disease severity in comparison to untreated control and farmer practices. Minimum average severity (24% and 27.67%) for Purple blotch (PB) and Stem phylum Blight (SPB) respectively were observed on plots applied recommended irrigation scheduling at 5 day interval and mancozeb fungicides. Maximum average severity (63.33% and 58.33) for Purple blotch (PB) and Stem phylum Blight (SPB), respectively were observed on Control plots (unscheduled irrigation and fungicide unsprayed plot) followed by farmer practices plot (54% and 48.67)for Purple blotch (PB) and Stem phylum Blight (SPB), respectively.

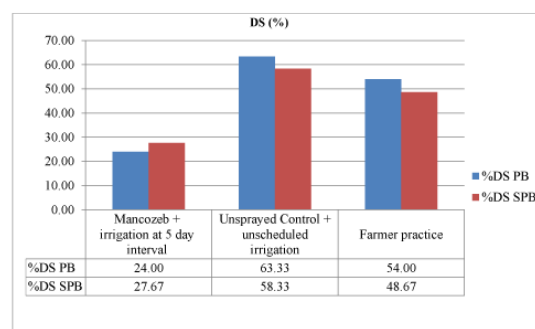


Figure 1: Average terminal Purple blotch and Stem phylum blight diseases severity

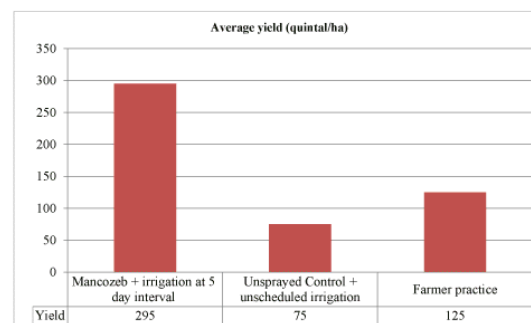


Figure 2: Average demonstration yield of onion.

Effect of Irrigation Scheduling and fungicide on Yield of demonstrated onion

The results (Figure 2) show that use of recommended irrigation scheduling and fungicide increases the yield of onion in comparison to farmer practices and untreated control. Maximum average bulb yield (295quintal/ha) was obtained on plots applied recommended irrigation scheduling at 5 day interval and mancozeb fungicides sprayed followed by plot with farmer practices(125quintal/ha). Minimum average onion bulb yield (75quintal/ha) was recorded control plot (unscheduled irrigation and fungicide unsprayed plot). The result revealed that the effect of recommended irrigation scheduling at 5 day interval and mancozeb fungicides that reduced the purple blotch and stem phylum diseases of onion was also reflected finally on bulb yield increment Figure 1.

Actors and their roles during the demonstration

From planning to the whole process of implementation agro-pastoralists, DAs Researchers, Woreda experts and LLRP project focal person zonal and woreda level will be participated actively for the sustainability of the technology.

Training of Pastorals, Agro-pastorals and other stakeholders

Both theoretical and practical training were given for target pastoral and agro-pastorals (25 PAPREGS) and Developmental agents (2), on the recommended onion production technical packages which mainly focused on proper preparation of land, irrigation scheduling, diseases identification based symptoms, time of disease appearance, fungicide and proper application methods.

Field day process, events and feedbacks obtained from stakeholders

The field days were organized by Jinka Agricultural research Centre in collaboration with Benna-Tsemay woreda Agricultural offices involving model pastorals and agro pastorals, development agents, agro pastorals from trial sites and out of trial sites, researchers with multidisciplinary, NGOs and respective higher officials. Field day process includes demonstration field visit, asking question and detailed discussion, experience sharing and encourage future demand creation among agro pastorals.

During the field visit, pastorals and agro pastorals expressed as they were interested and happy with the demonstrated onion variety (Nafis) along with recommended fungicide (mancozeb) and irrigation scheduling (25mm/5days) for its resulting highest bulb yield, marketable bulb yield, and low disease severity and highest net of return. Participant pastorals and agro pastorals were thanking all concerned bodies involved in the demonstration and they were expressing their interest to continuously growing this improved variety of onion along with proper disease management and proper irrigation scheduling methods.

On closing time of the field day program pastorals and agro pastorals were reminding the research centre and respective agricultural offices to continue supplying/ providing the improved variety of onion and other crops along with their pest management option and proper irrigation scheduling suitable for their areas. Experts from all levels were also confirmed that the onion variety (Nafis) has good performance in the area and utilization of technology such as proper diseases management and proper irrigation scheduling are profitable for onion production when compared with pastorals and agro pastorals practice and untreated control. The offices of agriculture promised to provide technical support to

pastorals and agro pastorals onion production technologies including proper disease management and irrigation scheduling through different educational and extension method to manage the diseases and water use to maximize yield and net return Figure 3.

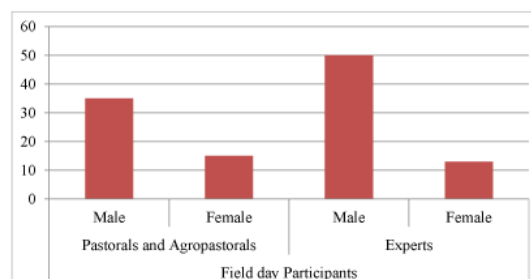


Figure 3: Participant stakeholders during field day



Bulb from Demonstrated technology Bulb from Agro pastorals practice

Figure 4: Pastoral and Agro-pastorals (PAPREGS and non-PAPREG member), Development Agents and Woreda Experts on theoretical and practical training on field day prepared at Enchete kebele in Benna-Tsemay woreda, South Omo zone

During the field day of the demonstration study pastorals and agro pastorals (50) and experts (63) were participated and expressing their feeling on the demonstrated technology Figure 4.

Table 2 Onion technology was demonstrated for 25PAPREGS (10Male and 15Female) and preference data was taken and analysed. Agro pastorals selected based

Table 2: Direct Matrix ranking of agro-pastoral preference on demonstrated technology

Preference criterion	Mancozeb fungicides with 25mm/5 day interval irrigation scheduling			Pastorals and Agro-pastoral practice			Unsprayed control and unscheduled irrigation practice		
	Very good	Good	Poor	Very good	Good	Poor	Very good	Good	Poor
Bulb Yield	21	4	-	2	21	2	0	0	25
Bulb size	23	2	-	5	20	-	0	0	25
Early maturity	21	4	-	4	21	-	0	0	25
Disease tolerance	25	-	-	3	22	-	0	0	25
Marketable bulb	22	3	-	5	18	2	0	0	25
Average score	89.6	10.4	-	15.2	81.6	3.2	-	-	100
Rank	1st				2nd				3rd

Table 3: Economic analysis of demonstrated technology

Economic Parameters	Mancozeb fungicides with 25mm/5 day interval irrigation scheduling	Agro-pastoral practice	Unsprayed and unscheduled irrigation practice	Average
Yield q/ha	295	125	75	165
Cost of cultivation (ETB/ha)	76200	77300	39600	64366
Gross return(ETB)/ha	472000	200,000	40000	264000
Net return(ETB)/ha	395800	122,700	400	199634
B:C ratio	6.19	2.59	1.01	4.10

on five selection criteria with three scoring criteria. The result shows that most of Agro pastoralist (89.6%) ranked Mancozeb fungicides with 25mm/5 day interval irrigation scheduling as very good methods in terms of Bulb yield, Bulb size, disease tolerance, early maturity and marketable bulb compared with agro-pastoral practice was ranked as good (81.6 %). The reason why they give good on their practice was they said that simply application of water irrigation without scheduling cause the occurrence of disease and rotting of onion bulbs when compared with demonstrated improved technology. In addition unscheduled water application increase competition among neighbour agro pastorals. Most of them use pesticides without knowledge of the pests and result is not such enough when compared with improved disease management and irrigation scheduling technology demonstrated. They promised that they need to adopt and can continue to use demonstrated technology for future to increasing onion production and to improve food security Table 3.

After consideration of all cost incurred during demonstration and their current prices, benefit and cost analysis was conducted to ensure that improved onion production technologies are desirable and economically sound. The highest net return (395800ETB/ha) was obtained from improved technology used (Mancozeb fungicides with 25mm/5 day interval irrigation) when compared with agro pastoral practices and control. This means that household who participated in onion

production would get averagely a profit of 7985.36ETB/ha. Moreover, the benefit-to-cost ratio of onion production was 4.1:1, which indicated that each household gets a benefit from onion production nearly four times the cost of production. This result would motivate new agro-pastoralists to use profitable demonstrated technology to increase onion production.

Field day were organized and many agro pastorals within and around the Kebele were participated and the technology were promoted through different media and televisions. Agro pastorals visit the demonstration plots and evaluated it by different criteria and expressed the strength and weakness of the demonstrated technology.

Strength

- Nafis variety was the most preferred varieties when compared with previously produced variety Bombay red. Agro pastorals indicated that Nafis was selected due to its early maturing, higher yield potential, good bulb size and moderately tolerant to disease. Also the variety was preferred since it has good skin colour for its high marketability.
- Mancozeb fungicide and irrigation scheduling is the most effective technology for minimize disease effect and yield increment
- Environmental and personal safeguard measures demonstrated during pesticide application

Weakness

- Unavailability of Nafis seed in local market
- High pest incidence and labour shortage
- Irrigation water variability

Conclusion and Recommendation

The current research finding shows that, there was a difference among the demonstrated technology when compared with agro pastorals practices. The highest bulb yield and the lowest average severity of purple blotch and stemphyllum blight diseases were observed on plots with recommended irrigation scheduling (25mm/5days) and mancozeb fungicide treated. Therefore, the mancozeb fungicides with 25mm/5 day interval irrigation scheduling were recommended for the study area to control purple blotch and stem phylum blight and to increase yield of onion. Thus, offices of agriculture and research centers need to provide technical support to the pastoral and Agro-pastoral on irrigation schedule, diseases symptom, time of diseases appearance and proper fungicide application method through different educational and extension method to manage the diseases and irrigation scheduling to maximize yield and net return.

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Conflicts of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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