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Performance Evaluation of Tomato (*Lycopersicon esculentum* Mill.) Varieties Under Supplemental Irrigation at Erer Valley, Babile District, Ethiopia

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Abstract: Farmers in Babile district of Ethiopia cultivate tomato from unknown seed sources and small fruit sizes, which lead to low fruit yield. The framers also produce this variety only during main cropping season even though irrigation water is available. Farmers should produce improved tomato variety at least two times per year using irrigation water to increase their production on their limited land. As tomato is being consumed, growers have to grow crops with high yield, good quality and well performed to their environment. Considering these problems, a field experiment was conducted at the Erer valley on farmers land during offseason of the two consecutive years to evaluate tomato varieties under irrigation water and recommend high fruit yielding variety to the area. The results revealed that there was significant ($P \leq 0.05$) differences among varieties for plant height, days to flowering, fruits per cluster, clusters per plant, average fruit weight and fruit yield per hectare, except primary branches per plant. 'Melkashola' and 'Bishola' out yielded among the varieties; 30.86 t ha^{-1} and 26.96 t ha^{-1}, respectively over the two years. 'Melkashola' and 'Bishola' 'Melkashola' and 'Bishola' advanced fruit yield per hectare by about 40% and 35% over the 'Babile local', respectively. However, farmers preferred 'Melkashola' due to its fruit size and shape over 'Bishola' which is extreme in fruit size and was susceptible to sun scald. Therefore, 'Melkashola' was recommended to the area for its high fruit yield per hectare under irrigation during offseason cropping.

Keywords: Bishola, Irrigation, Melkashola, Tomato

1. Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important edible and nutritious vegetable crops in the world. It ranks next to potato and sweet potato with respect to world vegetable production. It is widely cultivated in tropical, sub-tropical and temperate climates and thus ranks third in terms of world vegetable production [7]. The leading tomato producing countries are China, the United State of America, India, Egypt, Turkey, Iran, Mexico, Brazil and Indonesia [7]. A total of 7,255.93 hectares of land was under tomato in the country and yielding about 81,738.05 tones of tomato production in Ethiopia [4]. Tomato is an essential ingredient in the diet of the people and often used in almost every household. It is used in preparing soups, sauces, stews, salads and other dishes, and used in large quantities as compared to other vegetables [5]. The fruit is fairly nutritious and contains high amount of vitamins A and C [3]. Such diverse uses make the tomato an important vegetable in irrigated agriculture in Ethiopia and the production is rapidly increasing in many parts of the country. However, local production of tomato in eastern Harerghe is not able to meet the domestic demand. This has led to high supply of tomato from other parts of the country. The landholding of Ethiopian farmers is so much fragmented with most farmers owning a piece of land less than a hectare. The rainfall pattern is so erratic and intensive throughout when it rains. Currently, it is being tried to harvest rain water using different water harvesting structures and using it in combination with gravity drip system. This is useful especially for vegetable

production which can augment farmers' income and nutritional intake.

Tomato generally requires warm weather and abundant sunshine for best growth and development. The climatic soil conditions of Ethiopia allow cultivation of a wide range of fruit and vegetable crops including tomato, which is largely grown in the eastern and central parts of the mid- to low-land areas of the country. Large scale production of tomato takes place in the upper Awash valley, under irrigated and rain-fed conditions whereas small scale production for fresh market is a common practice around Koka, Ziway, Wondo-Genet, Guder, Bako and many other areas [11]. In 2008, tomato production in Ethiopia reached about 41, 815 tons from a total harvested area of 3542 ha [8]. The shortage of varieties and recommended information packages, poor irrigation systems, lack of information on soil fertility, diseases and insect pests, high postharvest loss, lack of awareness of existing improved technology and poor marketing system are the major constraints in Ethiopian tomato production [11]. In Ethiopia, several tomato varieties had been released nationally and recommended by the Melkassa Agricultural Research Center for commercial production and small scale farming systems in Ethiopia. Varieties such as 'Melkashola' and Marglobe' are widely produced while 'Melkasalsa' and 'Heinz 1350' have limited distribution and production. On the other hand, 'Fetan', 'Bishola', 'Eshete' and 'Matedel' are being tested [11]. In Eastern part of Ethiopia, especially Harerghe farmers produce locally known tomato variety on their gardens which is very small in size and low fruit yield. Tomato production is rare due to shortage of rainfall and irrigation water unavailability. However, some farmers those settled around the rift valley of Babile produce local tomato on small units of land for consumption and rarely for income generation. Therefore, it is important to evaluate different tomato varieties under irrigation during offseason to recommend high fruit yielding variety/varieties for the study area. Thus, the objective of this study was to evaluate performance of tomato varieties under supplemental irrigation and recommend the best performed variety.

2. Materials and Methods

The study site, Erer valley of Babile Woredas, is located at 34 km from Harar city in eastern direction in eastern part of Ethiopia in Oromia Regional State at lowland of Harerghe Zone. The altitude of the area ranges between 950 - 2000 meters at sea level and, latitude of 09°10'41.5" and 042°15'27.3", respectively. The area receives an average annual rainfall of about 400 - 600mm. Ten tomato varieties were used in the experiment, five of which are determinate (Chali, Bishola, Melka Shola, Melka Salsa, Fetane) while another four are indeterminate (Miya, Eshete, Metadel and R/VF). The one variety is farmers variety (Babile local). The study was conducted under irrigation for two consecutive years during offseason. Seedlings were raised in nursery beds at Erer valley, the beds were thoroughly prepared, 5m x 1m in size, raised 15 cm from the soil surface. The seeds were sown in rows spaced 10cm apart and covered lightly with fine soil before irrigation. The beds were irrigated every two days until germination then twice a week. The treatments consisted of nine improved and one farmers (Babile local) tomato. The experimental plots were laid out in Randomized Complete Block Design (RCBD) with three replications. Tomato seedlings were carefully transplanted at 12 cm height to the prepared plots with 4 m x 1.8 m dimensions to accommodate 24 plants per plot at a recommended spacing of 100 cm x 30 cm between rows and plants, respectively (Lemma, 2002). Furrow irrigation was applied weekly from pond through water pump. Standard agronomic practices such as weeding, cultivation, irrigation, fertilizer application and staking were carried out uniformly during the growing season for all plots. Fruit was harvested at the mature green stage. All quantitative data (days to 50% flowering, number of branches per plant, plant height (cm), number of bunches per plant, average number of fruits per bunches, average fruit weight (g), fruit yield per hectare (kg/ha)) were collected. Data were analyzed using GenSTAT statistical software package and mean values or Least Significant Differences (LSD) were compared using the procedures of Duncan's at the 5% level of significance.

3. Results and Discussion

3.1. Plant Height and Branches

Eshete and Babile local had significantly ($P \leq 0.05$) different from the others in plant height in the two years of cropping (Figure 1), however, Melkasalsa, Bishola and Miya were significantly ($P<0.05$) different in number of branches in the 2012/2013 cropping season only. The mean value of plant height ranges between 39.34 cm and 96.67 cm. The tallest plant was 'Eshete' followed by 'Babile local', 'R/VF' and 'Melkashola' over the two years while the shortest were 'Chali', 'Miya', Melkasalsa' and 'Fetane'(Table 2). This study was in agreement with the findings of Meseret *et al.*, 2012) who stated that the plant height of tomato varieties range between 40.20 cm and 107.00 cm. These results coincide with the findings of [9] and [12] also reported differences in plant height among cultivars/hybrids of tomato put under evaluation and screening trials. The tallness, shortness and other morphological differences are varietal characteristics, which are controlled and expressed by certain genes.

Melkasalsa was the only variety significantly ($P<0.05$) different in the number of primary branches from the remaining varieties in 2012/2013(Figure 2). However, it did not show significant differences over the two years (Table 2). These results are in close conformity with the findings of [16] who reported significant variation among the cultivars of tomato for the number of branches per plant.

3.2. Flowering Days, Fruits Cluster Per Plant and Fruit Number Per Cluster

Melkashola was the only significantly ($P<0.05$) different variety in days of flowering in 2012/2013; however, it did not

show significant differences in the 2013/2014 (Figure 3). The period between transplanting and flowering ranged from 36 to 42 days. This findings was in line with the statement of Meseret *et al.* (2012) who put days to flowering of tomato varieties between 38 to 49 days. This differences might be due to the high temperature (about 35°C) of the study area that could speed up the growth of reproductive parts of the plant. Fruit cluster per plant and fruits per plant were significantly ($P \leq 0.05$) different among the varieties for the two consecutive years (Table 1). The mean fruit clusters per plant laid between 7 to 16 while the number of fruits per cluster ranged from 1.67 to 3.33 in the 2012/2013 and. 'Melkashola' and 'Babile local' provided the highest fruit clusters per plant while 'Eshete' and 'Fetane' were the lowest. Low fruits per cluster was obtained from 'Chali', 'Bishola' and 'Fetane' while maximum number of fruits per cluster obtained from 'Metadel'. This study was in agreement with the findings of [10] and [1] who indicated that average number of fruits per cluster lay between 2.27 and 5.89. However, [13] reversely stated that except for 'Jimma local', all the tomato varieties tested achieved the maximum number of fruits per cluster. This result was in agreement with findings of [17] who reported that the maximum number of fruits per plant was obtained with 'Melka shola' (75.33) followed by 'Melka-selsa' (64.33) and the minimum number was in varieties, 'Fetan' (15.0) and'Mira-1' (15.67).

3.3. Average Fruit Weight and Fruit Yields

Total fruit yield per hectare and average fruit weight were significantly ($P \leq 0.05$) different among the varieties over the two years (Table 2). 'Bishola' and 'Metadel' were the biggest fruit size and maximum fruit weight while the remaining varieties were smallest in fruit weight and statistically in paired. Fruit weight might be attributed due to varietal genetic makeup as well as effect of ecological conditions. [2] also attributed poor tomato yield to non-development of flowers into fruits and he found that only 50% of the flowers produced developed into fruits and limit the size and weight of fruits. The maximum fruit yield per hectare were obtained from 'Melkashola', 'Bishola' while the minimum were from 'Chali', 'Fetan' and 'Babile local'(Table 2). The mean values ranged between 18557 kg/ha and 30863 kg/ha. Other tomato researchers ([15]; [11]; [6]; [13]) showed that total fruit yield ranged between 6.46 and 82.50 t/ha. 'Bishola provided maximum fruit yield next to 'Melkashola' due to its maximum fruit weight because fruit weight, fruit clusters per plant and number of fruits per plant are directly correlated to fruit yield. The varietals differences in growth and yield might be attributed to the differences in ecological distribution of the tomato varieties [14]. Besides the differences of varietal genetic makeup, the low marketable yield obtained for some tomato varieties used might be due to non-development of flowers into fruits as about 50% of the flowers developed into fruits.

Table 1. *Mean performance of fruit yields and some agronomic parameters for the two consecutive years.*

	2012/2013				2013/2014			
Varieties	**Fruit clusters/plant**	**Number of Fruits/cluster**	**Fruit weight (g)**	**Fruit/yield (kg/ha)**	**Clusters/plant**	**Fruits/cluster**	**Fruit weight (g)**	**Fruit/yield (kg/ha)**
Miya	9.33d	2.67ab	43.00b	22827abc	23.00bc	3.67ab	40.00b	26696ab
Chali	9.00d	2.00ab	44.17b	17708c	19.53c	3.33ab	41.17b	21280ab
Bishola	12.00c	3.00ab	85.33a	27351ab	18.40c	2.33cd	90.33a	30030ab
Eshete	8.00d	3.00ab	40.33b	25476abc	14.67c	3.00bc	38.33b	28452ab
M/Shola	15.67ab	3.33a	49.67b	29673a	41.67ab	3.33ab	45.67b	32054a
M/Salsa	7.67d	2.33ab	35.00b	22560abc	28.00bc	4.00a	30.33b	27321ab
Fetan	7.00d	1.67b	44.83b	18393c	15.13c	2.00d	48.83b	19881b
R/ VF	16.33a	3.33a	42.00b	17708c	28.73bc	3.33ab	39.00b	20089b
Matedel	14.00bc	2.33ab	77.00a	23780abc	17.27c	3.00bc	84.00a	26756ab
Local	13.67bc	3.33a	35.00b	19464bc	52.13a	3.67ab	33.00b	20655ab
LSD	2.17	1.2	16.4	7496.8	17.39	0.8	23.32	10351.3
CV%	11.2	26	19.3	19.4	39.2	14.8	27.7	23.8

NS: non-significant, * Significant at P≤0.05, Means in the same column sharing the same letter(s) are not significantly different at P=0.05.

Table 2. *Mean performance of yield and some agronomic parameter over the two years (2012-2014).*

Treatments	**Plant height (cm)**	**Branches/plant**	**50% Flowering days**	**Clusters/plant**	**Fruits/Cluster**	**Fruit weight (g)**	**Fruit yield (kg/ha)**
Miya	44.63cd	7.800	36.50c	14.87de	3.167ab	41.50b	24762abc
Chali	39.43d	7.100	39.17abc	14.27def	2.667b	42.67b	19494c
Bishola	56.23bcd	7.567	37.00c	15.43d	2.667b	87.83a	28690a
Eshete	96.67a	6.833	39.67abc	11.83ef	3.000ab	39.33b	26964ab
M/shola	60.87bc	7.300	42.00a	24.63a	3.333ab	47.67b	30863a
M/salsa	46.23cd	8.067	38.50bc	17.50cd	3.167ab	32.67b	24940abc
Fetan	46.40cd	6.433	39.67abc	11.07f	1.883c	46.83b	19137c
R/ VF	64.00bc	6.833	37.67c	20.37bc	3.333ab	40.50b	20402bc
Matedel	53.03bcd	6.633	36.17c	15.63d	3.667a	80.50a	25268abc
Local	71.07b	6.767	40.67ab	23.33ab	3.500ab	34.00b	18557c
LSD	24.6	NS	4.359	4.304	0.9754	19.04	8478.1
CV%	25.7	31.4	6.8	15.4	20.1	23.3	21.5

NS: non-significant, * Significant at P≤0.05, Means in the same column sharing the same letter(s) are not significantly different at P=0.05.

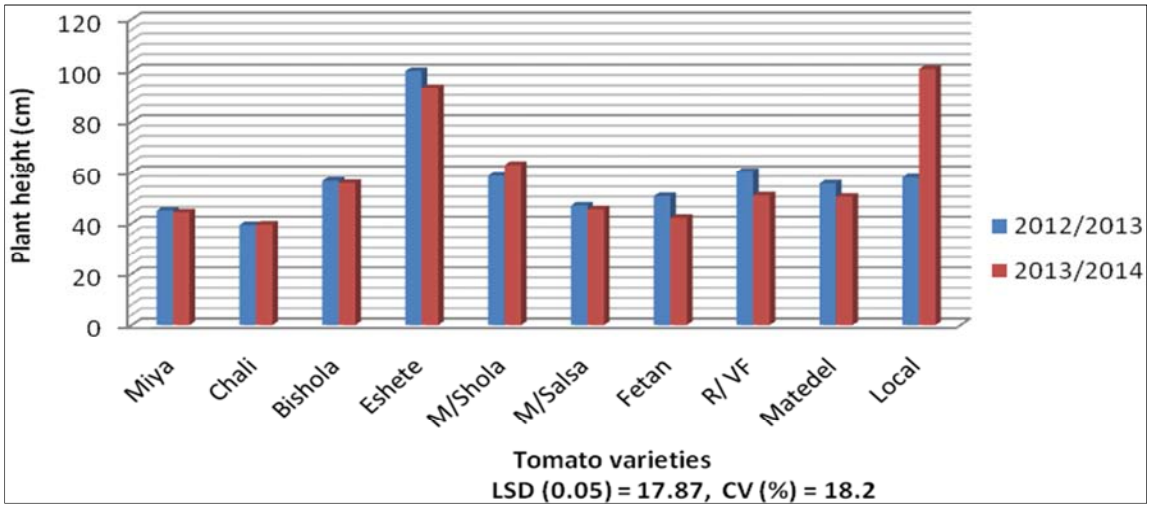

Figure 1. *Response of varieties on plant height over the two years.*

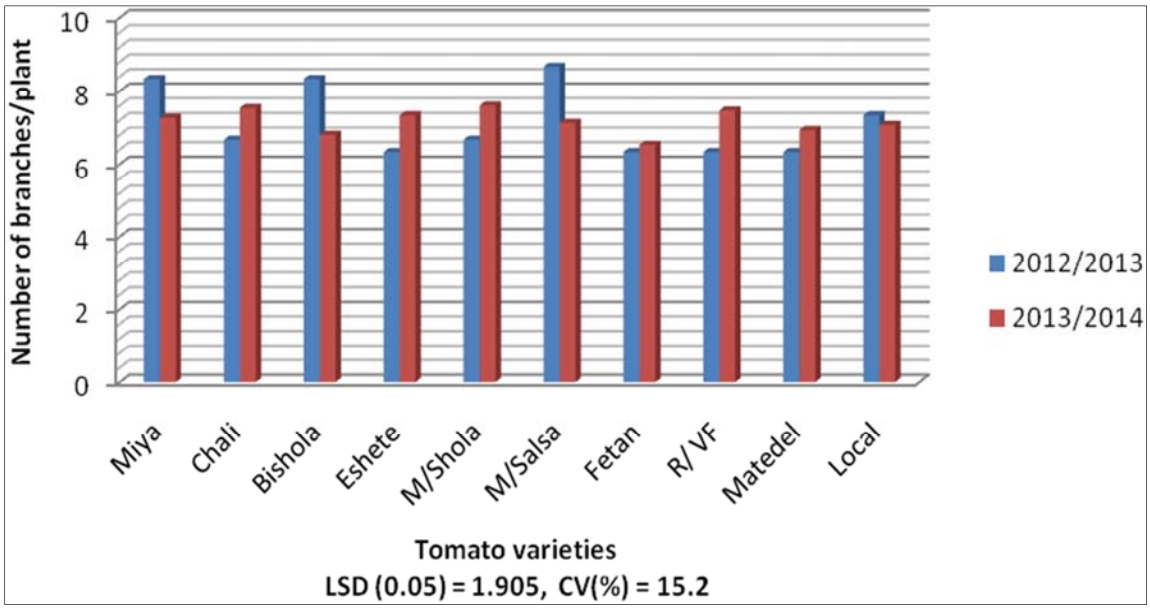

Figure 2. *Response of varieties on number of branches per plant over the two years.*

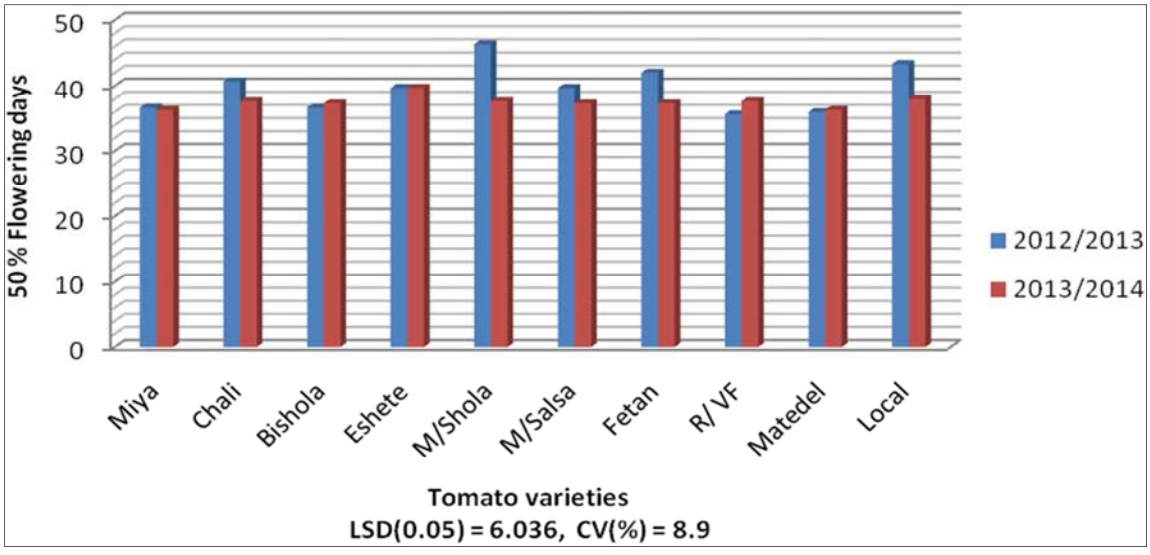

Figure 3. *Response of varieties on flowering date over the two years.*

4. Conclusion and Recommendation

Tomato is one of the most widely accepted fruits in the world. As tomato is being consumed, growers have to grow crops with high yield, good quality and well performed to their environment. As indicated in the results there was significant differences among the varieties for all parameters, except average number of primary branches per plant. 'Melkashola' and 'Bishola' were increased fruit yield per hectare by about 40% and 35% over the 'Babile local'. However, farmers preferred 'Melkashola' due to its fruit size and shape over 'Bishola' which is extreme fruit size. Therefore, 'Melkashola' was recommended to the area for its high fruit yield per hectare under irrigation during offseason cropping.

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References

[1] Abrar, H. S., Shams, U. I., Noor, U. I. and Safdar, H. 2011. evaluation of two nutrient solutions for growing tomatoes in non-circulating hydroponics systems. *Journal of Agriculture* 27 (4), 558-567.

[2] Adelana, B. O. 1975. Effect of staking on growth and yield of tomatoes, *E. Afr. J*., 41 (3): 243-249.

[3] AVRDC. 2004. Medium-term plan: 2004-2006. High lights. AVRDC-The World Vegetable Center, Shanhua, Taiwan.

[4] Central Statistic Authority. 2012. Report of Federal Democratic Republic of Ethiopia, Statistical Report on Socio-Economic Characteristics of the Population in Agricultural Households, Land Use, Area and Production of Crops. Addis Ababa, Ethiopia.

[5] Ellis. 1998. Postharvest problems of tomato production in Ghana -Field studies of some selected major growing areas in Ghana. Journal of the Ghana science association volume 1 number 1, July (1998) pp. 55-59. ISSN: 0855-3823.

[6] Falak, N., Ihsan, U. I., Syed, A., Abdus, S. and Abdur, R. 2011. Studies on growth, yield and nutritional composition of different tomato cultivars in Battal Valley of district Mansehra, Kyyber Pakhtunkhwa, pakistan, *Sarhad Journal of agriculture* 27 (4), 570-571.

[7] FAO. 2006. FAO Production Year Book. Basic Data Unit, Statistics Division, FAO, Rome, Italy, No. 55, pp 125-127.

[8] FAO. 2009. Statistical Bulletin, Rome, No. 150, pp 1-2.

[9] Kallo, G. and Chaurasia, S. N. G., Major, S. and Singh, M. 1998. Stability analysis in tomato. Vegetable Science 25 (1): 81-84.

[10] Khah, E. M., Kakava, E., Mavromatis, A., Chachalis, D. and Goulas, C. 2006. Effect of grafting on growth and yield of tomato (*Lycopersicon esculentum* Mill.)in greenhouse and open field. *Journal of Applied Horticulture* (8), 3-7.

[11] Lemma, D. 2002. Research experience and production prospects. Ethiopian Agricultural Research Organization (EARO), Addis Ababa, Ethiopia, pp 20-28.

[12] Manoj, R. and Raghav, M. 1998. Performance of F1 hybrids and high yielding varieties of tomato under mid-west plains of Uttar Pradesh. Progressive Horticulture 30 (3): 194-197.

[13] Meseret, D., Ali, M. and Kassahun, B. 2012. Evaluation of tomato (*Lycopersicon esculentum* Mill.) genotypes for yield and yield components. *The African Journal of Plant Science and Biotechnology,* pp 45-49.

[14] Olaniyi, J. O. 2007. Evaluation of Yield and Quality Performance of Grain Amaranth Varieties in the South western Nigeria. *Res. J. Agron*., 1 (2): 42-45.

[15] Palada, C. and Allison, M. 2001. Yield performance of tomato cultivars grown under organic management system. *Proceeding of the Caribbean Food Crop Society* (37), 154-160.

[16] Sharma, S. K. and Rastogi, K. B. 1993. Evaluation of some tomato cultivars for seed production under mid hill conditions of Himachal Pradesh. Annals of Agricultural Research in India 14 (4): 494-496.

[17] Tadele Shiberu. 2016. Evaluation of Improved Tomato Varieties *(Lycopersicon Esculentum* Mill.) Performance against Major Insect Pests Under Open Field and Glasshouse Conditions. *International Journal of Research Studies in Agricultural Sciences (2),* pp 1-7.