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Short communication

Effect of plant population and mulching on wild watermelon growth and yield

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ABSTRACT

A field study of wild watermelon (*Citrullus lanatus*) establishment and yield using seed to compare the effects of different population densities (3,000, 6,000, 9,000 and 12,000 plants ha^{-1}) and mulching rates (0, 2.5 and 5 t ha^{-1}) with grass mulch on soil water, temperature, vine length, number of branches and leaves per plant, fruit number per plant and per hectare, total yield, fresh and dry fruit mass was conducted. The fruit per hectare and total yields increased as the plant population increased resulting in high yields in the range from 6,000-12,000 plants per hectare. Yield was more influenced by plant population than by mulching. Mulching did not affect growth and yield of wild watermelon but it affected soil temperature and soil moisture. More water was conserved, while soil temperature was reduced upon increased mulching. This was shown by 31 and 12.6% increase in volumetric water content when the amount of mulch was increased by 2.5 and 5 t/ ha, respectively. However, this was associated with only 1°C change in temperature, which may be significant for critical stages of plant growth.

Key words: mulch, population density, seed, wild watermelon, yield.

Wild watermelon (*Citrullus lanatus*) is an indigenous crop that was among the most important foodstuffs consumed by Africans when they lived nomadic lifestyle of moving from one place to another. Indigenous crops including wild watermelon still play an important role in the lives of rural communities as sources of food (Modi, 5). Propagation of cucurbits in any production system is usually by means of seed, which may be directly seeded in the field and occasionally grown in seed-trays as seedlings depending on growth factors. Plant density whether through seed or seedling propagules can affect the yield potential at a given site by influencing the utilization of available solar radiation and soil moisture reserves during the growing season (Cook *et al*., 2).

Mulching, as a crop production technique, involves placement of organic or inorganic materials on the soil surface, so as to provide a more favorable environment for plant growth and development (Debashis *et al*., 3). Literature reveals that mulch suppresses weeds, conserves moisture and regulates soil temperature for plant growth and development (Yakubu and Karaye, 7; Cook *et al*., 2; Debashis *et al*., 3). Use of plastic mulches (inorganic materials) and straw (organic materials) has been documented with watermelons and melons quite extensively as reported by Hansen (4) but there are no reports on mulching of wild watermelons. Therefore, the objective of this study was to determine the effects of seed propagules and mulching using grass on wild watermelon growth and yield.

The study was conducted at Campagna, Döhne Agricultural Development Institute (DADI) in the Amahlathi District, Eastern Cape Province, South Africa (32°31´S; 27°28´E; altitude 780 m). The area has a warm temperate climate with a mean annual rainfall ranging between 600 and 1000 mm received mainly during the summer months of October to April. The mean monthly rainfall and temperature during the growing season are shown in Table 1. Soils in the study area are of the oak leaf soil form (Soil Classification Working Group 1991, 6) and the soil texture is sandy-clay-loam with slightly acidic reaction. Details of soil

Table 1. Monthly rainfall and temperature distribution at the experimental site (Campagna, Döhne) during the growing season (2009-2010).

Month	Rainfall (mm)	Temp (°C)
October	66.6	16.91
November	53.1	18.45
December	28.2	19.56
January	106.3	21.86
February	88.7	23.48
March	80.8	21.76
April	31.1	18.81

Source: ARC Soil Climate & Water weather services.

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mechanical and chemical characteristics are given in Table 2. Wild watermelon seed used for the study was supplied by the University of KwaZulu-Natal and originally collected from Centane (in the Eastern Cape). The organic material used for mulching was a common grass (*Panicum maximum* Jacq.).

The experiment was a combination of population densities and mulching laid in a randomized complete block design with three replications. The four population densities were (3000, 6,000, 9,000 and 12,000 plants ha^{-1}) based on the commercial watermelon's optimum density that was found to range from 6,000 to 9,000 plants ha^{-1} and three mulching rates based on the availability of grass were 0.0, 2.5 and 5 t ha^{-1} of grass. The land was ripped before ploughing to break the plough pan and thereafter conventionally prepared. A basal fertilizer treatment at the rate of 100 kg 2:3:4 (30), 100 kg LAN and 50 kg KCl were applied. Four rows of wild watermelon were planted per 8 m × 8 m plot at an inter-row spacing of 2.1 m and an intra-row spacing of 160, 80, 53 and 42 cm for a target population of 3,000, 6,000, 9,000 and 12,000 plants ha^{-1}. Three seeds were hand planted per hole (6th November) and plants were later hand-thinned to the desired plant population, two weeks after emergence. Cutworm bait was applied immediately after planting as a control measure against cutworms. Application of mulch treatments (0, 2.5 and 5 t ha^{-1}) of designated plots was done immediately after hand weeding. Weeding control of the experiment was only done once before the mulch application. Soil temperature was measured 100-150 mm below the soil surface by using a digital thermometer in each plot during the day. Soil moisture was sampled at 150 mm depth weekly below the soil surface by manual coring and gravimetric moisture content of the soil samples was calculated on oven-dry weight basis to determine volumetric moisture content using equation: $\theta v = \theta m. \rho s/\rho w$ (FSSA, 8); where: θv = Volume base, θm = $M_{w/}$ M_s, M_w = mass water (kg), M_s = mass oven dried soil (kg), ρs = bulk density of soil (kg m^3), ρw = density of water (kg m^3).

Three plants were randomly selected from two middle rows per plot a week after mulch application for data collection. Data regarding vine length, vine number (branches) and leaves were recorded on a weekly basis until 50% flowering. Data recording on the above growth parameters occurred twice due to severe hailstorm damage that occurred on 6 January, 2010. The recovery period for watermelon took two weeks and thereafter the crop reached 50% flowering stage which resulted in termination of data collection. Data were analyzed by two-way analysis of variance (ANOVA) by treatment and block using Genstat 14th Edn. to generate values of least significant differences, which were declared significant at 5% level.

Volumetric water content was significantly influenced by population density and mulch (Table 3). Less water was conserved as the plant population density increased compared to lower plant population. The recorded high moisture content at 3,000 plants ha^{-1} was possible that the plants experienced little or no competition for limited environmental resource (water) compared to the higher plant population. Conversely, more water was conserved as the mulch increased compared to no mulch and this meant that the higher the mulch density, the higher the soil water retention capacity. The higher retention capacity at higher mulch rate showed the importance of mulch in conserving water. Mulch has the ability to modify the radiation budget of the soil surface thereby suppressing soil water evaporation (Cook *et al*., 5). Mulch also significantly influenced soil temperature. The higher mulch rate (5 t ha^{-1}) had a significantly lower soil temperature compared to other mulch rates (0 and 2.5 t ha^{-1}). The reduced soil temperature obtained in this study confirmed the results obtained on maize by Cook *et al*. (5).

There were no significant differences recorded for yield on any of the measured parameters in response to mulch. Yet, with population density significant differences were noted on fruit number per hectare and total yield at ($p \leq 0.05$) (Table 4). The number of fruits and total yield per hectare increased, while fruit production per plant decreased as population density increased. In general, high population density (12,000 plants ha^{-1}) produced most fruits/ ha suggesting that the yield increase with a narrower spacing due to a higher plant population and lower fruit production per plant. Similar results were obtained on melons and garlic by Ban *et al*. (1) and Yakubu *et al*. (7), respectively. Based on the results, plant population

Table 2. Soil mechanical and chemical characteristics of the experimental site.

Mechanical analysis (%)					Chemical Analysis mg (kg) soil					
Sample density (g/ml)	Medium sand (%)	Fine sand (%)	Silt (%)	Clay (%)	N%	Ca	Mg	P	pH	K
1.32	12.8	50.1	9.4	27.8	0.03	1396	318	33	5.5	80

Table 3. Soil temperature, volumetric water content and growth parameters of wild watermelon as affected by population density and mulch.

Treatment	Volumetric water content (mm)	Soil temp. (°C)	Height (m)	No. branches	No. of leaves
Plant popln. (plants ha^{-1})					
3,000	3.728 b	24.35 a	1.806 b	4.539 a	89.67 b
6,000	3.533 a	24.32 a	1.447 a	4.178 a	76.03 ab
9,000	3.517 a	24.46 a	1.643 ab	4.283 a	68.82 a
12,000	3.559 a	24.32 a	1.671 ab	4.317 a	76.07 ab
Mulching (t ha^{-1})					
0.0	3.092 a	24.64 b	1.552 a	4.329 a	68.78 a
2.5	3.602 b	24.38 b	1.781 a	4.500 a	80.80 a
5	4.057 c	23.99 a	1.614 a	4.158 a	80.37 a
P	*	NS	NS	NS	NS
M	**	**	NS	NS	NS
P × M	NS	NS	NS	NS	NS

**Significant differences with P< 0.001; * significant differences with P < 0.05; NS = Not significant

Table 4. Yield parameters of wild watermelon as affected by population density and mulch.

Treatment	Fruit No. pl^{-1}	Fruit No. ha^{-1}	Total yield (kg ha^{-1})	Fresh fruit mass (kg pl^{-1})	Dry fruit mass (kg pl^{-1})
Plant population (plants ha^{-1})					
3,000	1.310 a	71.30 a	106.7 a	1.473 a	0.3736 a
6,000	1.354 a	104.6 b	170.0 bc	1.612 a	0.3934 a
9,000	1.209 a	114.4 bc	159.9 b	1.421 a	0.3301 a
12,000	1.207 a	128.6 c	215.4 c	1.680 a	0.3699 a
Mulching (t ha^{-1})					
0.0	1.231 a	101.5 a	153.3 a	1.511 a	0.3340 a
2.5	1.236 a	101.5 a	158.0 a	1.548 a	0.3607 a
5.0	1.343 a	111.2 a	177.6 a	1.581 a	0.4054 a
P	NS	**	**	NS	NS
M	NS	NS	NS	NS	NS
P × M	NS	NS	NS	NS	NS

**Significant differences with P< 0.001; * significant differences with P < 0.05; NS = Not significant

density had a profound influence on yield whether mulched or un-mulched hence increased yields at high population density. The intermediate population densities (6,000 and 9,000 plants ha^{-1}) irrespective of not mulched or mulched could be recommended as optimum population density for wild watermelon.

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