

TITLE: EVALUATION OF GARLIC CULTIVARS FOR ONTARIO GROWING CONDITIONS IN THE 2018-2019 FIELD SEASON

CROP: Garlic (*Allium sativum* L.)

AUTHORS: CRANMER T.J
Ontario Ministry of Agriculture, Food and Rural Affairs

MATERIALS: Garlic (*Allium sativum* L.), cvs. Music, Newfoundland, Ivan, Portugal 1 Azores, Mount Hood, Yugoslavian Red, Georgian Fire, Russian Red, Red Russian, Kranagasger Red, Duganski MPS, Duganski White, Purple Glazer, Guelph, Ukraine, Polish White, Sicilian Gold, Transylvanian, Nootka Rose, Saba Gold, Messadore, Thermadore.

OBJECTIVES: Compare yield, fresh and dry bulb weights of 22 garlic cultivars.

METHODS: Garlic cloves of 22 cultivars previously grown in Ontario were seeded by hand in three locations; Gorrie in Huron clay loam on 13 October, 2018, Dashwood in Huron clay loam on 16 October, 2018, and Ridgetown College in Wattford loamy sand 30 October, 2018. Hardneck cultivars include Music, Newfoundland, Ivan, Portugal 1 Azores, Mount Hood, Yugoslavian Red, Georgian Fire, Russian Red, Red Russian MPS, Kranagasger Red, Duganski MPS, Duganski White, Purple Glazer, Guelph, Ukraine, and Polish White. Softneck cultivars include, Sicilian Gold, Transylvanian, Nootka Rose, Saba Gold, Messadore and Thermadore. The average clove sizes for each cultivar were equal for each planting location. Cultivars were planted in a randomized complete block design with four replicate rows. Each row had 10 cloves of garlic planted per row at a depth of two inches. Planting densities varied based on location with ~170k plants per acre in Ridgetown and ~65k plants per acre in Dashwood and Gorrie. Black plastic was used as weed control at the Ridgetown location while plants were hand weeded as necessary at the other two locations. No plants received irrigation throughout the season. Scape stage was quantified 19 June in Gorrie and 26 June for Dashwood and Ridgetown by measuring the direction of the spathe in relation to the scape rising from the plant using a 0–2 scale where 0 = no scape observed, 1 = one full loop and 2 = two full loops. The scape stage at 21 June reflects when the scapes would most likely be harvested and may not reflect the final scape stage. The trial was harvested 24 July in Ridgetown, 25 July in Gorrie and 26 July in Dashwood. At harvest, bulb basal plates were rated for damage by assessing the percentage of basal plate missing using a 0–4 rating scale: where 0 = no damage; 1 = 1 – 24% basal plate missing; 2 = 25 – 50% basal plate missing; 3 = > 50% basal plate missing and 4 = completely desiccated bulb. Bulbs were cured in mesh bags within a pallet box in a forced air dryer over an 11 day period from 26 July to 6 August. Dry weights were collected on 21 August. Data were analyzed using SAS version 9.3 (SAS Institute, Cary NC). Means were separated using Tukey-Kramer multiple mean comparison test ($P = 0.05$).

RESULTS: Flooding at the Gorrie location caused poor emergence for the first and second repetition. The plants that survived the unfavourable conditions at Gorrie are included for interest, as a few cultivars performed well despite the flooding. Height assessment on 15 May, found Polish White, Ukraine, Transylvanian, Guelph, Portugal 1 Azores, Purple Glazer, Mount Hood, Duganski MPS and Georgian Fire to be the tallest at the Dashwood location while Polish White, Mount Hood, Ukraine, Music and Portugal 1 Azores were the tallest at Ridgetown (Table 1, 2). Most of the hardneck cultivars had more leaves per plant than the softneck cultivars at the 15 May assessment at both locations with Transylvanian being the best performing softneck cultivar. Scape assessment showed a wide variation in the progression of the scape and no cultivars showed a double loop, as was seen in the 2017–2018 trial with Ivan. The strong bolting cultivars showed scape development as expected and no scapes were observed in the softneck cultivars. No cultivars displayed a straight scape and the umbel capsule/topset characteristics

were not assessed. At harvest, the plant fresh weight found Portugal 1 Azores, Ukraine, Polish White, Duganski MPS, Red Russian MPS, Kranagasger Red and Mount hood to be the heaviest at the Dashwood location with Polish White, Duganski MPS, Red Russian MPS, Ukraine and Portugal 1 Azores weighing the most at Ridgetown. The marketable dry weight of Polish white, Portugal 1 Azores, Ukraine, Guelph, Transylvanian, Duganski MPS and Mount Hood showed no significant difference from Music at Dashwood. At Ridgetown, the marketable dry weights of Polish White, Duganski MPS, Ukraine, Transylvanian, and Red Russian MPS were significantly higher than Music. Transylvanian was consistently the top performer of the softneck cultivars in fresh and dry weights at both locations. When comparing the fresh bulb weight to the clove weight at planting to get a multiplication value/rate (clove wt at planting x bulb to clove ratio = fresh bulb wt), there were not many significant differences between cultivars at the Ridgetown location, while at Dashwood Sicilian Gold, Nootka Rose, Russian Red, Purple Glazier, Saba Gold, Transylvanian, Portugal 1 Azores all performed significantly better; however the average clove planting size of Russian Red, Sicilian Gold and Nootka rose were small to start. At the Dashwood location, the largest bulbs when it came to circumference were from Duganski White & MPS, Polish White, Ukraine, Red Russian, Portugal 1 Azoles, Transylvanian, Kranagasger Red, Sicilian Gold, Mount Hood, Guelph, Purple Glazer, and Music. The greatest circumferences at the Ridgetown location were Duganski MPS, Red Russian MPS, Polish White, Kranagasger Red, Transylvanian and Ukraine. No significant differences were observed in basal plate rot at harvest. Cultivars were not tested for bulb and stem nematode or virus load prior to planting or after harvest.

CONCLUSIONS: Most cultivars that recorded a taller height and an increase in number of leaves at the 15 May assessment also had the largest bulb weight at harvest. Many of the cultivars trialed performed better than the predominately grown cultivar in Ontario – Music – and most had a higher rate of multiplication from the time of planting to the final average bulb weight. The majority of the cultivars highlighted in this report will be assessed again in the 2019–2020 field season in Ridgetown and Dashwood. Further research should explore the storability of the various cultivars to determine if storage duration can be extended relative to Music.

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Table 1. Assessments at Dashwood with height and leaf number collected 18 May, fresh weights collected 26 July and dry weights collected 21 August.¹

Cultivar	Assessments at Dashwood										
	Clove Weight at Planting (g)	Height (cm) May 15, 2019	Leaf Number May 15, 2019	Plant Fresh Weight (g)	Fresh Bulb Weight (g)	Marketable Dry Weight (kg) ¹	Bulb to Clove Ratio	Diameter (cm)	Bulb Circumference (cm)	Basal Plate Rot ²	Bulb Wrapper Colour
Music	7.6 f	28.2 a-d	5.1 abc	116 c-f	59.9 c-g	0.464 a-f	7.9 def	5.3 b-g	16.4 abc	0.0 b	Pinkish White
Newfoundland	6.8 g	23.7 c-h	5.0 abc	81 g-j	44.7 fgh	0.249 efg	6.6 f	4.8 fgh	14.7 bc	0.0 b	White
Ivan	5.5 i	26.3 b-f	4.8 a-d	83 g-j	43.3 fgh	0.318 d-g	8.0 def	4.8 fgh	14.2 bc	0.1 b	White
Portugal 1 Azores	10.1 b	29.1 a-d	5.4 ab	176 a	90.2 a	0.613 abc	9.0 def	6.1 ab	18.8 abc	0.0 b	Pinkish White
Mount Hood	9.8 bcd	27.7 a-e	5.6 ab	140 a-e	73.1 a-e	0.475 a-f	7.5 ef	5.7 a-e	17.6 abc	0.0 b	Pinkish White
Yugoslavian Red	4.1 k	24.9 b-h	4.3 def	65 ij	40.5 fgh	0.146 g	10.0 def	4.9 e-h	14.9 bc	1.1 a	Pinkish White
Georgian Fire	6.2 h	26.8 a-e	5.3 abc	97 f-j	52.6 d-h	0.372 c-g	8.5 def	5.1 d-h	15.6 bc	0.1 b	White
Russian Red R	2.1 m	23.0 d-h	3.8 efg	58 j	33.1 h	0.205 fg	15.8 bc	4.5 gh	13.6 bc	0.4 ab	Purple Stripe
Red Russian MPS ³	9.9 bc	26.0 b-f	5.2 abc	155 abc	81.1 abc	0.392 b-g	8.2 def	6.1 ab	18.8 abc	0.2 b	Purple Stripe
Kranagasger Red	9.5 de	28.4 a-d	5.3 abc	149 a-d	76.2 a-d	0.390 b-g	8.1 def	6.0 abc	18.6 abc	0.1 b	Pinkish White
Duganski-MPS ³	11.0 a	27.3 a-e	5.1 abc	166 ab	89.6 a	0.486 a-f	8.1 def	6.3 a	19.1 ab	0.1 b	Pinkish White
Duganski-White	5.3 i	21.5 e-h	4.5 cde	123 c-g	66.4 a-f	0.468 -f	12.5 bcd	5.6 a-f	21.6 a	0.1 b	Purple Stripe
Purple Glazer	5.3 i	28.5 a-d	4.9 a-d	97 e-j	62.8 b-f	0.519 a-e	11.8 cde	5.5 a-f	16.9 abc	0.1 b	White
Guelph	9.2 e	29.3 a-d	5.6 ab	132 b-f	71.0 a-e	0.537 a-d	7.8 ef	5.6 a-f	17.5 abc	0.0 b	Pinkish White
Ukraine	10.0 bc	30.4 ab	5.5 ab	176 a	88.0 ab	0.662 ab	8.8 def	6.1 ab	18.9 ab	0.0 b	Pinkish White
Polish White	9.7 cd	33.0 a	5.6 a	168 ab	88.0 ab	0.721 a	9.1 def	6.1 ab	19.0 ab	0.0 b	Pinkish White
Sicilian Gold	3.0 l	18.1 h	3.7 efg	103 e-i	67.9 a-f	0.376 c-g	22.6 a	6.0 a-d	17.8 abc	0.1 b	Pinkish White
Transylvanian	7.0 g	29.6 abc	4.8 bcd	109 d-i	77.5 a-d	0.538 a-d	11.1 def	6.0 abc	18.7 abc	0.0 b	Pinkish White
Nootka Rose	3.3 l	24.7 b-g	3.6 fg	96 f-j	55.4 d-h	0.346 c-g	16.8 b	5.3 b-g	15.7 bc	0.0 b	White
Saba Gold	4.2 k	19.9 f-h	3.6 fg	74 hij	47.8 e-h	0.293 d-g	11.5 cde	5.1 c-h	15.8 bc	0.0 b	Light Brown
Messadore	4.0 k	19.1 gh	3.5 fg	56 j	34.7 gh	0.200 fg	8.7 def	4.3 h	13.2 c	0.0 b	Light Brown
Thermadore	4.7 j	18.9 gh	3.2 g	73 ij	45.7 fgh	0.246 efg	9.7 def	4.9 e-h	15.1 bc	0.3 ab	Light Brown

¹ Marketable weight was determined by combining all marketable cloves within a single replicate² Basal plate rot rating is calculated by assessing the percentage of basal plate missing using a 0-4 rating scale: where 0 = no damage, 1 = 1 - 24% basal plate missing; 2 = 25 - 50% basal plate missing; 3 = > 50% basal plate missing and 4 = completely desiccated bulb³ Marbled Purple Stripe

Table 2. Assessments at Ridgetown with height and leaf number collected 15 May, fresh weights collected 24 July and dry weights collected 21 August.¹

Cultivar	Assessments at Ridgetown										
	Clove Weight at Planting (g)	Height (cm) May 15, 2019	Leaf Number May 15, 2019	Plant Fresh Weight (g)	Fresh Bulb Weight (g)	Marketable Dry Weight (kg) ¹	Bulb to Clove Ratio	Diameter (cm)	Bulb Circumference (cm)	Basal Plate Rot ²	Bulb Wrapper Colour
Music	7.6 f	48.5 abc	6.0 abc	49 cde	28.8 c-f	0.195 e-j	3.8 bc	4.0 cde	12.2 def	0.0ns	White
Newfoundland	6.8 g	43.2 b-e	5.6 bcd	32 de	21.3 ef	0.160 g-j	3.1 c	3.7 e	11.5 ef	0.0	White
Ivan	5.5 i	47.3 bcd	5.7 a-d	37 cde	24.4 def	0.171 g-j	4.4 bc	3.8 de	11.8 def	0.1	White
Portugal 1 Azores	10.1 b	48.2 abc	6.1 abc	98 ab	52.7 abc	0.367 abc	5.2 abc	4.7 a-d	15.0 abc	0.0	White
Mount Hood	9.8 bcd	51.8 ab	6.2 ab	62 cd	40.5 a-f	0.315 b-e	4.1 bc	4.5 a-e	14.0 b-e	0.0	White
Yugoslavian Red	4.1 k	33.7 fgh	3.6 f	32 de	19.9 ef	0.075 j	4.9 abc	3.8 de	11.3 f	0.3	Pinkish White
Georgian Fire	6.2 h	43.4 b-e	5.8 a-d	46 cde	29.5 c-f	0.217 d-i	4.8 abc	4.1 cde	12.7 c-f	0.1	White
Russian Red R	2.1 m	35.8 e-h	4.2 ef	26 e	18.4 f	0.107 hij	8.8 abc	3.6 e	11.0 f	0.1	Purple Stripe
Red Russian MPS ³	9.9 bc	42.5 b-f	6.0 abc	106 a	58.4 ab	0.345 a-d	5.9 abc	5.3 ab	16.5 ab	0.3	Purple Stripe
Kranagasger Red	9.5 de	44.2 b-e	6.1 abc	95 ab	47.2 a-e	0.264 b-g	5.0 abc	4.8 abc	15.1 abc	0.1	White
Duganski-MPS ³	11.0 a	41.4 c-g	6.0 abc	124 a	64.5 a	0.384 ab	5.9 abc	5.5 a	17.0 a	0.1	Pinkish White
Duganski-White	5.3 i	36.4 e-h	4.9 cde	51 cde	32.9 b-f	0.244 c-h	6.2 abc	4.3 b-e	13.2 c-f	0.1	Pinkish White
Purple Glazer	5.3 i	45.9 bcd	5.6 bcd	53 cde	38.1 a-f	0.301 b-f	7.2 abc	4.4 b-e	14.0 b-e	0.0	Pinkish White
Guelph	9.2 e	43.6 b-e	5.6 bcd	66 bc	41.5 a-f	0.270 b-g	4.5 abc	4.2 cde	14.3 bcd	0.0	White
Ukraine	10.0 bc	51.6 ab	6.2 ab	102 a	50.1 a-d	0.382 abc	5.0 abc	4.8 abc	15.0 abc	0.0	White
Polish White	9.7 cd	56.7 a	6.9 a	125 a	59.0 ab	0.459 a	6.1 abc	5.2 ab	15.9 ab	0.1	White
Sicilian Gold	3.0 l	33.2 fgh	4.6 def	47 cde	29.4 c-f	0.161 g-j	9.8 ab	4.3 b-e	12.8 cdef	0.3	Pinkish White
Transylvanian	7.0 g	47.0 bcd	5.7 bcd	67 bc	46.2 a-e	0.378 abc	6.6 abc	4.8 abc	15.1 abc	0.0	White
Nootka Rose	3.3 l	36.3 efgh	4.3 ef	57 cde	32.2 b-f	0.136 g-j	9.8 ab	4.5 b-e	12.9 c-f	0.0	White
Saba Gold	4.2 k	31.5 h	4.2 ef	26 e	20.6 ef	0.085 ij	5.0 abc	3.7 e	11.3 f	0.2	Light Brown
Messadore	4.0 k	32.3 gh	4.2 ef	25 e	44.4 a-f	0.094 ij	10.9 a	3.7 e	11.2 f	0.7	White
Thermadore	4.7 j	38.4 d-h	4.6 def	59 cd	37.8 a-f	0.214 d-i	8.1 abc	4.6 a-e	14.1 bcd	0.2	White

¹ Marketable weight was determined by combining all marketable cloves within a single replicate

² Basal plate rot rating is calculated by assessing the percentage of basal plate missing using a 0-4 rating scale: where 0 = no damage, 1 = 1 - 24% basal plate missing; 2 = 25 - 50% basal plate missing; 3 = > 50% basal plate missing and 4 = completely desiccated bulb

³ Marbled Purple Stripe

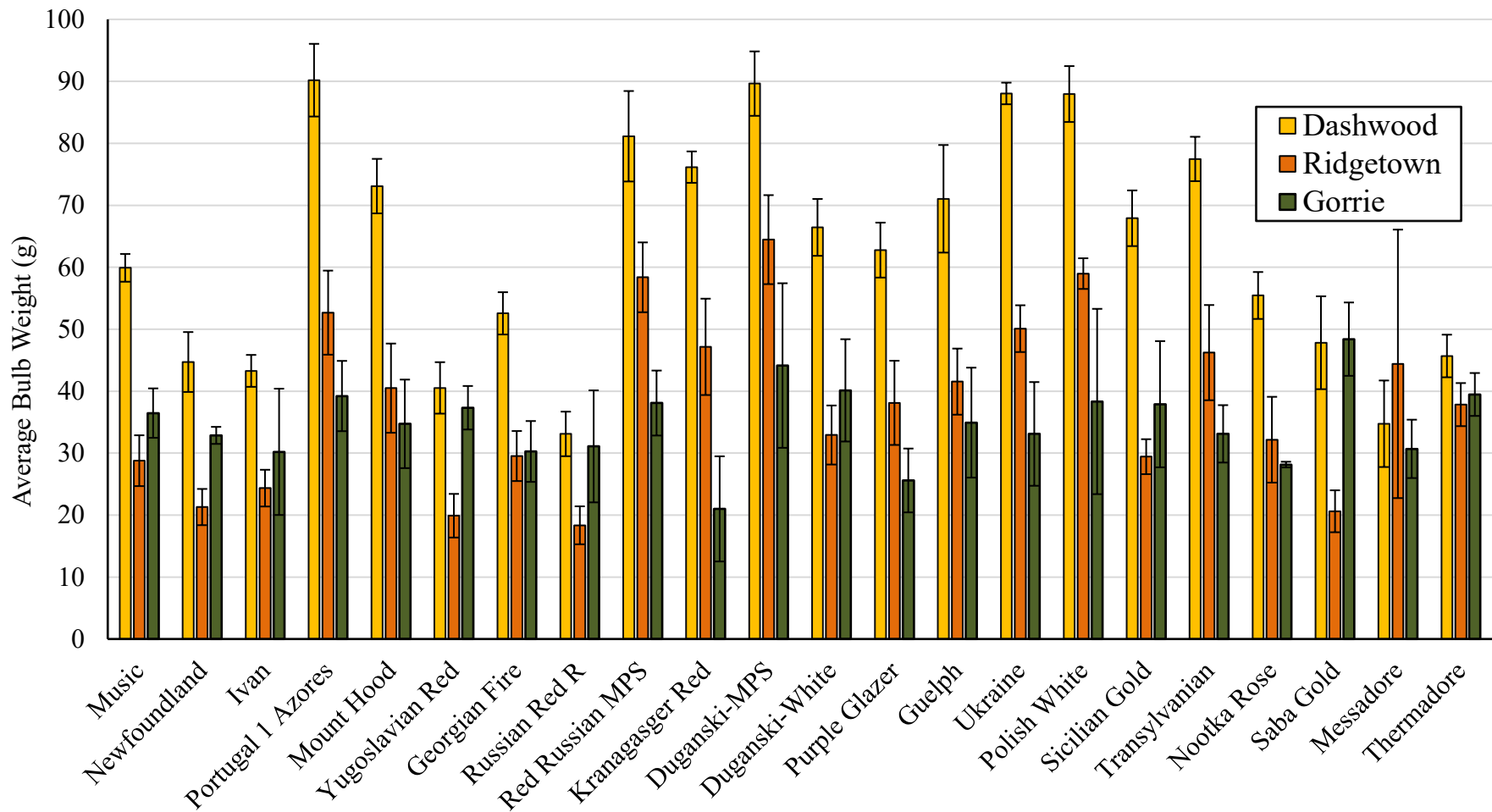


Figure 1. Fresh bulb weight in grams at harvest July 24 in Ridgetown, July 25 in Gorrie and July 26 in Dashwood. The average of four replicates is presented by the standard error. Many plants failed to emerge at the Gorrie location due to flooding. R=Racombole, MPS=Marbled Purple Stripe

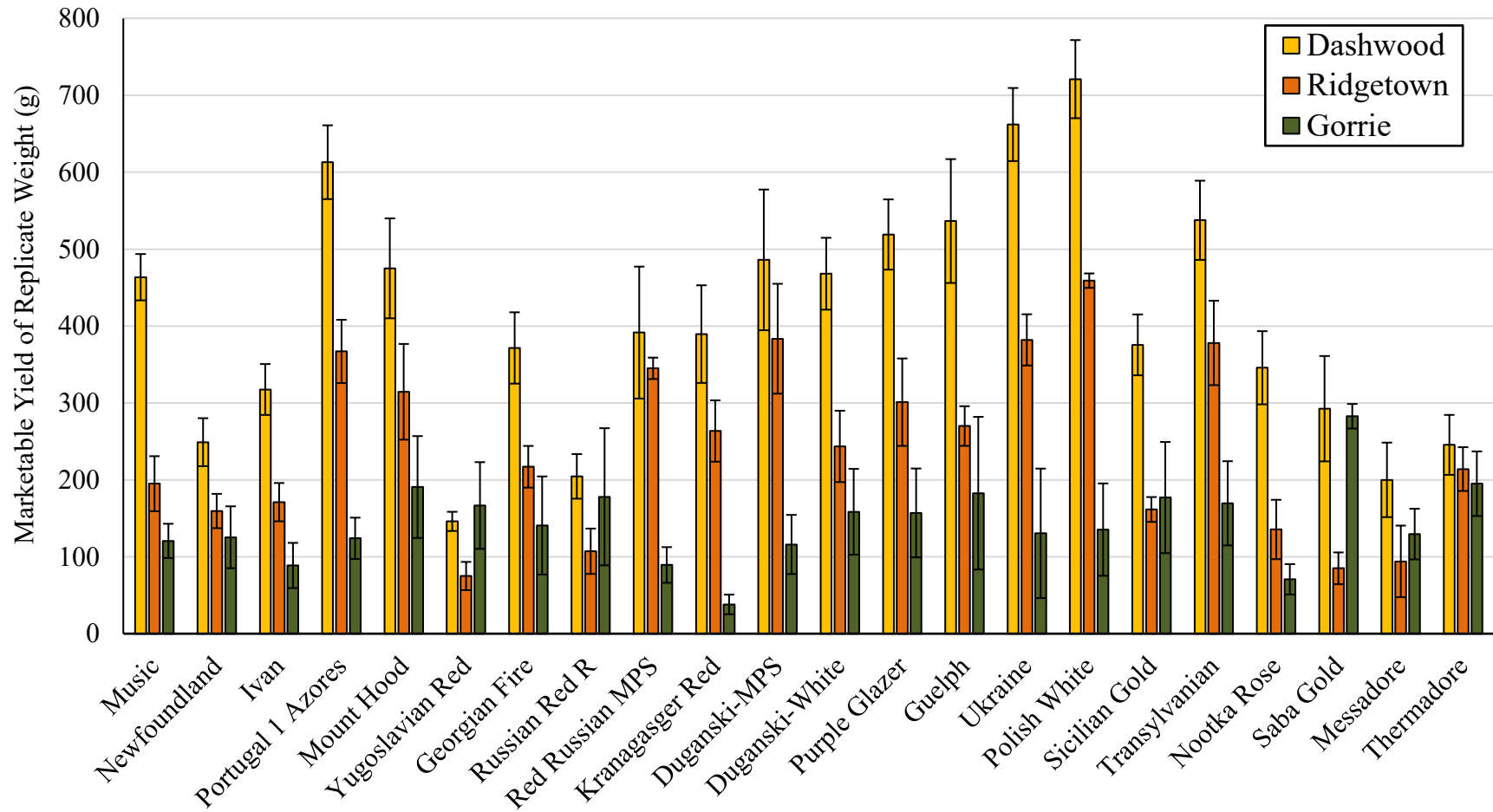


Figure 2. Marketable yield (dry weight) after curing 21 August, 2019. The average of four replicates is presented by the standard error. Many plants failed to emerge at the Gorrie location due to flooding. R=Racombole, MPS=Marbled Purple Stripe

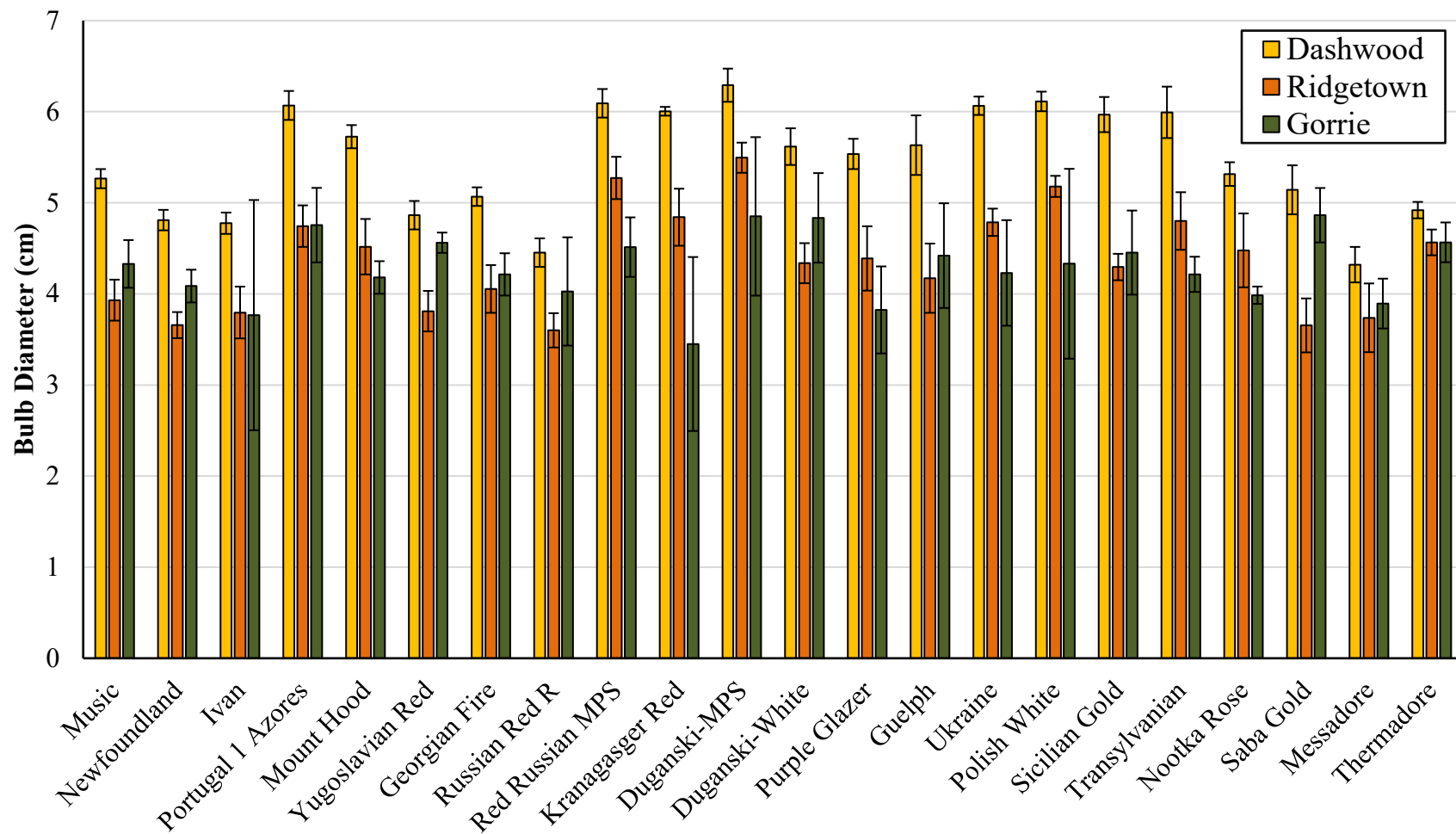


Figure 3. Bulb diameter at harvest July 24 in Ridgetown, July 25 in Gorrie and July 26 in Dashwood. The average of four replicates is presented by the standard error. Many plants failed to emerge at the Gorrie location due to flooding. R=Racombole, MPS=Marbled Purple Stripe

Table 3. Scape stage of garlic cultivars in Dashwood, Ontario observed 26 June. Scape stage was by the direction of spathe after looping. None = no scape observed, 1 = one full loop and 2 = two full loops. Scape stage at 26 June reflects when the scapes would most likely be harvested and may not reflect the final scape stage.^{1,2}

Cultivar	Scape Stage 26 June (%) ²									
	None	< ¼	¼	½	¾	1	1 ¼	1 ½	1 ¾	2
Music	0.0	0.0	0.0	0.0	2.6	5.3	23.7	68.4	0.0	0.0
Newfoundland	0.0	0.0	0.0	0.0	15.4	3.8	30.8	50.0	0.0	0.0
Ivan	2.9	0.0	0.0	0.0	2.9	2.9	34.3	57.1	0.0	0.0
Portugal 1 Azores	0.0	0.0	0.0	3.0	6.1	6.1	18.2	66.7	0.0	0.0
Mount Hood	0.0	0.0	0.0	9.4	0.0	15.6	15.6	59.4	0.0	0.0
Yugoslavian Red	3.2	3.2	0.0	48.4	45.2	0.0	0.0	0.0	0.0	0.0
Georgian Fire	0.0	0.0	0.0	14.3	2.9	11.4	28.6	42.9	0.0	0.0
Russian Red R	0.0	0.0	0.0	37.8	45.9	0.0	0.0	10.8	5.4	0.0
Red Russian MPS ³	0.0	0.0	3.1	21.9	71.9	3.1	0.0	0.0	0.0	0.0
Kranagasger Red	0.0	10.3	3.4	34.5	51.7	0.0	0.0	0.0	0.0	0.0
Duganski-MPS ³	14.3	0.0	0.0	5.7	80.0	0.0	0.0	0.0	0.0	0.0
Duganski-White	2.7	8.1	8.1	62.2	18.9	0.0	0.0	0.0	0.0	0.0
Purple Glazer	0.0	0.0	0.0	0.0	0.0	0.0	5.9	94.1	0.0	0.0
Guelph	0.0	0.0	0.0	0.0	0.0	0.0	25.0	75.0	0.0	0.0
Ukraine	0.0	0.0	0.0	0.0	0.0	8.3	33.3	58.3	0.0	0.0
Polish White	0.0	0.0	0.0	7.5	2.5	5.0	27.5	57.5	0.0	0.0
Sicilian Gold	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transylvanian	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nootka Rose	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saba Gold	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Messadore	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermadore	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

¹ Numbers in bold show the predominate scape stage of each cultivar

² Percentage was determined by the number of plants showing a particular loop stage divided by the total number of plants x 100

³ Marbled Purple Stripe

Table 4. Scape stage of garlic cultivars in Ridgetown, Ontario observed 26 June. Scape stage was by the direction of spathe after looping. None = no scape observed, 1 = one full loop and 2 = two full loops. Scape stage at 26 June reflects when the scapes would most likely be harvested and may not reflect the final scape stage.^{1,2}

Cultivar	Scape Stage 26 June (%) ²									
	None	< ¼	¼	½	¾	1	1 ¼	1 ½	1 ¾	2
Music	0.0	0.0	0.0	5.9	38.2	41.2	11.8	2.9	0.0	0.0
Newfoundland	0.0	0.0	0.0	18.2	45.5	6.1	6.1	24.2	0.0	0.0
Ivan	0.0	0.0	0.0	12.1	39.4	21.2	15.2	12.1	0.0	0.0
Portugal 1 Azores	0.0	0.0	0.0	5.9	35.3	32.4	11.8	14.7	0.0	0.0
Mount Hood	0.0	0.0	0.0	2.8	41.7	27.8	19.4	8.3	0.0	0.0
Yugoslavian Red	18.2	4.5	18.2	9.1	50.0	0.0	0.0	0.0	0.0	0.0
Georgian Fire	0.0	0.0	0.0	5.7	48.6	22.9	11.4	11.4	0.0	0.0
Russian Red R	3.7	3.7	18.5	63.0	11.1	0.0	0.0	0.0	0.0	0.0
Red Russian MPS ³	0.0	0.0	5.4	40.5	54.1	0.0	0.0	0.0	0.0	0.0
Kranagasger Red	6.5	3.2	29.0	32.3	29.0	0.0	0.0	0.0	0.0	0.0
Duganski-MPS ³	2.9	2.9	17.1	51.4	25.7	0.0	0.0	0.0	0.0	0.0
Duganski-White	8.1	2.7	27.0	54.1	8.1	0.0	0.0	0.0	0.0	0.0
Purple Glazer	0.0	0.0	0.0	0.0	15.4	12.8	12.8	51.3	7.7	0.0
Guelph	5.9	0.0	0.0	2.9	23.5	14.7	8.8	44.1	0.0	0.0
Ukraine	0.0	0.0	0.0	5.1	10.3	23.1	20.5	41.0	0.0	0.0
Polish White	0.0	0.0	0.0	2.5	30.0	27.5	22.5	17.5	0.0	0.0
Sicilian Gold	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transylvanian	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nootka Rose	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saba Gold	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Messadore	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermadore	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

¹ Numbers in bold show the predominate scape stage of each cultivar

² Percentage was determined by the number of plants showing a particular loop stage divided by the total number of plants x 100

³ Marbled Purple Stripe