

CROP: Garlic (*Allium sativum* L.), cv. Porcelain

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TITLE: EFFECT OF PLANTING DATES AND INTERCROPPING COVER CROPS ON GARLIC SURVIVABILITY AND BULB WEIGHT IN THE 2023-2024 FIELD SEASON.

METHODS: Garlic cloves were planted by hand near Dashwood, Ontario, in Huron clay loam, on six planting dates in 2023 (30 August, 13 September, 4 October, 24 October, 14 November, and 11 December) and 28 March in 2024. The trial was arranged in a randomized complete block design with four replicates. Each replicate consisted of five rows (3 m long) with 15 plants per row for a total of 75 plants per plot taking up 7 m² (75 sq ft) per experimental unit. Bulbs for the trial were set aside 30 August 2023 and cracked immediately prior to planting at each planting date. The remainder of the bulbs were stored at an average temperature of 16 °C and a relative humidity of 40 % until the last planting 28 March 2024. Rows were dug prior to planting and cloves were covered with 2–5 cm of soil and grown under standard cultivation conditions. Two seeding dates of oats were sown 30 August and 4 October at a rate of 112 kg/ha (100 lbs/ac) after cloves were planted. Plots were raked prior to and after broadcasting oats. A high rate of oats 225 kg/ha (200 lbs/ac) was also planted during the 30 August 2023 garlic planting date which consisted of a single plot that was not replicated and was not included in the statistical analysis. Crimson clover was seeded at a rate of 45 kg/ha (40 lbs/ac) between rows of emerging garlic on 28 March on some additional garlic plots that were planted on 14 November. One treatment planted 30 August was left un-weeded as a weeded check with the 30 August planting date acting as the weed-free check. Temperature and rainfall measurements were collected from October 2023 to July 2024 using a tipping bucket rain gauge and HOBO Onset data logger. Soil erosion by water was estimated using the Revised Universal Soil Loss Equation² (RUSLE2). Supplemental irrigation was added 21 May with irrigation applied as necessary up until two weeks until harvest. Scaping was conducted 11 June 2023. Plots without cover crops were hand weeded as necessary. Garlic was harvested, and cover crop and weed biomass was assessed on 22 July after an average of 50 % of the garlic leaves had senesced. After harvest, bulbs were cleaned, placed in mesh bags, and were cured in a pallet box within a forced air-drying shed for 10 days with garlic dry weights collected on 6 August. Cover crop and weed biomass samples were air-dried for 14-25 days, and dry biomass weights were recorded. 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: Different planting dates and cover crops had no statistical differences in dry bulb weight after curing (**Table 1**). The cover crop treatments did have statistical differences in reducing weed biomass (**Table 2**). All cover crop treatments reduced soil erosion from the field as modelled by RUSLE2 (**Table 3**).

CONCLUSIONS: The 2023 winter was relatively mild for Dashwood, ON, but there was limited snow cover to provide insulation during the coldest parts of winter. Different planting dates had no statistical differences in dry bulb weight after curing, however, the date with the highest bulb weight was 30 August. Although intended to winterkill, the oat cover crop planted 30 August with the earliest planted garlic had adequate time to establish before winter and as a result overwintered and resulted in a yield drag of 39% (-29.1 g/bulb) compared to the garlic-only planting. Garlic and oats planted 4 October only decreased the average garlic bulb weight by 3.3% (-2.4 g/bulb) yet provided a potential 135% reduction in

soil erosion compared to bare soil. Oats planted with garlic 30 August and the spring planted crimson clover resulted in some of the lowest garlic yields in the trial, although both cover crops reduced soil erosion potential significantly. All cover crops reduced weed presence in the trial plots, with both the 4 October oats and the 28 March crimson clover reducing weed biomass by over half (Table 2).

With no significant differences between the bulb weights between the different planting dates, garlic cloves could have been planted as early as 30 August, with no negative impact to yield or bulb weight at harvest in July 2024. Similarly, garlic cloves could be intercropped/overseeded with a fall-seeded oat cover crop to provide good weed suppression, considerable soil erosion reduction, and relatively small yield drag. The trial is to be replicated in 2024-2025 with similar planting dates to determine if varying winter conditions change survivability of early plantings.

Thank you to Josh Mosiondz, Joseph Roy, Dan Stein, Sasha VanDyk, Kendra Workman, Dennis Van Dyk, McKenzie Susil, Leah Ritcey-Thorpe, and Danny Jefferies for their help throughout 2023–2024 on this trial.

Table 1. Garlic survival and green weight measurements collected 22 July and dry weights collected 6 August for various planting dates on garlic grown near Dashwood, Ontario, 2023–2024.^{1,2}

Garlic Planting Date	Cover Crop	Cover Crop Planting Date	% Plant Survival	Green Weight for 30 Bulbs (kg)	Dry Weight for 30 Bulbs (kg)	Bulb Dry Weight (g)
30 August 2023	--	--	99.1 ns	3.03 a	2.27 ns	75.6 ns
13 September 2023	--	--	93.0	2.76 ab	2.13	71.0
4 October 2023	--	--	81.7	2.80 ab	2.16	71.8
24 October 2023	--	--	67.7	1.74 ab	1.55	51.6
14 November 2023	--	--	92.0	2.59 ab	1.94	64.5
11 December 2023	--	--	92.3	2.42 ab	1.82	60.8
28 March 2024	--	--	80.7	1.89 ab	1.43	47.6
30 August 2023	Oats	30 August 2023	89.3	1.57 b	1.39	46.5
30 August 2023	Weedy check	--	96.3	2.80 ab	2.14	71.4
4 October 2023	Oats	4 October 2023	96.0	2.71 ab	2.08	69.4
4 October 2023	Crimson clover	28 March 2024	91.0	2.15 ab	1.61	53.7
30 August 2023	Oats high rate	30 August 2023	98.7	1.14	0.86	28.7

¹ All planting dates had four replications except for the 30 August 2023 garlic and high-rate oats planting date which consisted of a single plot and was not included in the statistical analysis.

² Numbers in a column followed by the same letter are not significantly different at $P = 0.05$.

Table 2. Cover crop and weed green weight collected 22 July and dry weights collected 16 August for various planting dates near Dashwood, Ontario, 2023–2024.^{1,2}

Garlic Planting Date	Cover Crop	Cover Crop Planting Date	Cover Crop Green Biomass (g)	Cover Crop Dry Biomass (g)	Weed Green Biomass (g)	Weed Dry Biomass (g)
30 August 2023	Oats	30 August 2023	200.3 b	108.3 a	12.8 c	3.6 c
30 August 2023	Weedy check	--	0.0 c	0.0 b	203.1 a	65.0 a
4 October 2023	Oats	4 October 2023	72.5 bc	39.5 b	90.0 b	29.7 b
4 October 2023	Crimson clover	28 March 2024	411.8 a	112.4 a	78.2 b	26.1 b
30 August 2023	Oats high rate	30 August 2023	243.7	129.0	24.7	5.3

¹ All planting dates had four replications except for the 30 August 2023 garlic and high-rate oats planting date which consisted of a single plot and was not included in the statistical analysis.

² Numbers in a column followed by the same letter are not significantly different at $P = 0.05$.

Table 3. Soil erosion estimates using RUSLE2 for the period of October 2023 to July 2024 for various planting dates and cover crop treatments near Dashwood, Ontario

Treatment	Cover Crop	Cover Crop Planting Date	Soil erosion rate (tons/ac)	Reduction in erosion (%) ¹
Average Inherent Erosion Rate ²	--	--	4.48	--
“Grower Management” ³	--	--	0.92	132%
Garlic 30 August 2023	Oats	30 August 2023	0.86	135%
Garlic 4 October 2023	Oats	4 October 2023	0.86	135%
Garlic 4 October 2023	Crimson clover	28 March 2024	0.68	147%

¹ Percent reduction in soil erosion based on average inherent water erosion rate

² Average inherent water erosion rate based on soil type and slope

³ “Grower Management” assumes wheat residue is left on soil surface and strip tillage is used prior to garlic planting

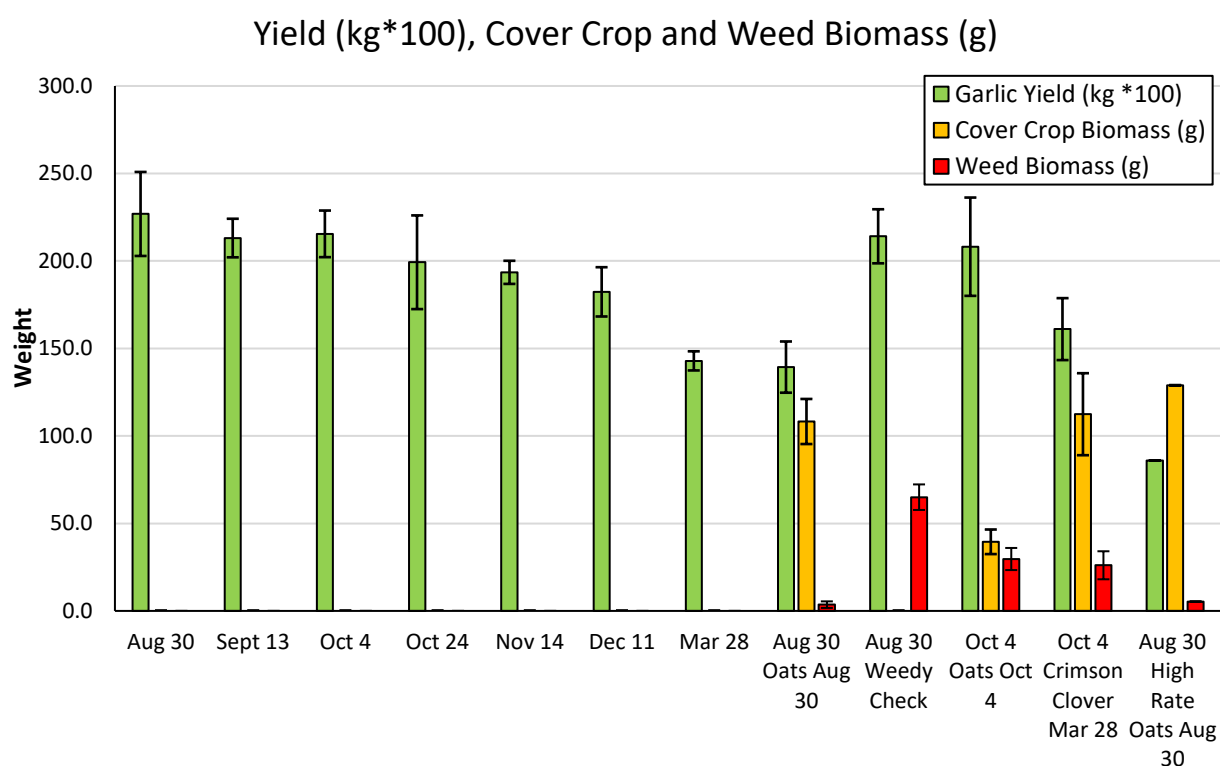


Figure 1. Cured garlic weight (kg*100) dry cover crop biomass (g) and dry weed biomass harvested 22 July 2024.



Figure 2. A) Oats seeded on 30 August, B) Oats seeded on 4 October. Photos taken on December 11, 2023.



Figure 3. A) Oats seeded on 30 August 2023, B) Crimson clover seeded on 28 March 2024. Photos taken on July 22, 2024.