EVALUATION OF KELPAK® AND DOMINATE® IN ONION PRODUCTION

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Introduction

Kelpak® (Caltec Ag, Inc., Modesto, CA) is a biostimulant produced from the seaweed *Ecklonia maxima.* Dominate® is a foliar fertilizer formula (19% nitrogen [N], 0.1 % phosphate [P_2O_5], 1% potash [K_2O], Caltec Ag, Inc). This trial evaluated whether Kelpak and Dominate could improve onion production.

Methods

Onions were grown on a Owyhee silt loam with a pH of 7.5 and 1.4% organic matter, previously planted to wheat. The field had last been planted to onion in 2009. Soil analysis revealed 20 ppm nitrate, 3 ppm ammonium, 21 ppm phosporus (P), 394 ppm potassium (K), 16 ppm sulfur (S), 2,543 ppm calcium, 600 ppm magnesium, 206 ppm sodium, 3.5 ppm zinc, 7 ppm manganese (Mn), 1.7 ppm copper, 19 ppm iron, and 1.2 ppm boron (B). In the fall of 2013, the wheat stubble was shredded and the field was irrigated. Based on the soil analysis, 87 lb of P/acre, 100 lbs of K/acre, 100 lbs of S/acre, 1 lb Mn/acre, and 1 lb of B/acre were broadcast. The field was then disked, moldboard plowed, groundhogged, fumigated with Vapam® at 17 gal/acre and bedded at 22 inches.

Onion seed of variety 'Avalon' (Crookham Seed Co., Caldwell, ID) was planted on March 21 on 22-inch beds in double rows spaced 3 inches apart at 150,000 seeds/acre. Seed was planted with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onions received a narrow band of Lorsban® 15G at 3.7 oz/1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled. Onion emergence started on April 7. On May 12, alleys 4 ft wide were cut between plots, leaving plots 23 ft long.

The experimental plots were four rows wide and 27 ft long. The experimental treatments consisted of three different combinations of Kelpak and Dominate and an untreated check (Table 1). The experimental design was a randomized complete block with four treatments and seven replicates.

Kelpak (1 qt/acre) and Dominate (1 gal/acre) were applied using a CO_2 sprayer with 4 8004 nozzles at 35 gal/acre. A penetrant and acidifier adjuvant (LI 700, Loveland Products, Greeley, CO) was added to the spray solution at 1 pt/100 gal of water.

Table 1. Kelpak and Dominate treatments applied to onions at three growth stages. Kelpak was applied at 1 qt/acre and Dominate was applied at 1 gal/acre. Malheur Experiment Station, Oregon State University, Ontario, OR 2014.

	Application timing, (number of leaves)		
Treatment	May 8 (1-2)	May 30 (4)	June 11 (6)
1	Check		
2	Kelpak		Dominate
3		Kelpak	Dominate
4	Kelpak	Kelpak	Dominate

The onions were managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. Prowl® H_2O, Goal Tender®, Buctril®, and Poast® were applied for weed control. On April 21, Prowl H_2O at 0.83 lb ai/acre (2 pints/acre) was broadcast. On May 8, Goal Tender at 0.09 lb ai/acre (4 oz/acre), Buctril at 0.25 lb ai/acre (16 oz/acre), and Poast at 0.38 lb ai/acre (24 oz/acre) were broadcast. On June 3, Goal Tender at 0.09 lb ai/acre (6 oz/acre), and Buctril at 0.25 lb ai/acre (16 oz/acre) were broadcast.

Thrips were managed using the following insecticides: Movento® at 5 oz/acre on May 16 and 27 (ground applications), Radiant® at 10 oz/acre on June 5 and July 12 (ground applications), Agri-Mek® at 16 oz/acre on June 19 (ground application), and 30 (aerial application), Lannate® at 0.9 lb ai/acre on July 6 and 13 (aerial applications), and Radiant at 10 oz/acre on July 22 and 27 (aerial applications).

Uran at 20 lb N/acre was applied through the drip tape on May 19 and 29. Starting on June 4, root tissue samples from the check treatment plots were taken every 2 weeks and analyzed for nutrients by Western Laboratories, Inc. Parma Idaho (Table 2). Nutrients were applied through the drip tape based on the tissue analyses (Table 3).

The trial was drip-irrigated (Shock et al. 2013a) when the soil water tension reached 20 cb (Shock et al. 2010, 2013b). Starting in early June, soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row in the drip and furrow irrigated areas. The sensors were automatically read three times a day with a datalogger (Irrometer Monitor Model 950 R1). The last irrigation was on August 24.

Onions in each plot were evaluated for maturity, severity of symptoms of iris yellow spot virus (IYSV), and bolting on August 21. Onions were evaluated subjectively for maturity by visually rating the percentage of onions with the tops down and the percent of dry foliage. For IYSV, each plot was given a subjective rating on a scale of 0 to 5 of increasing severity of IYSV symptoms. The rating was 0 if there were no symptoms, 1 if 1-25% of foliage was diseased, 2 if 26-50% of foliage was diseased, 3 if 51-75% of foliage was diseased, 4 if 76-99% of foliage was diseased, and 5 if 100% of foliage was diseased. The number of bolted onion plants was counted in each plot.

The onions were lifted on September 10 to field cure. Onions from the middle two beds in each four-bed plot were topped by hand and bagged on September 16. The bags were put in storage

on September 22. The storage shed was ventilated and the temperature was slowly decreased to maintain air temperature as close to 34°F as possible. Onions were graded out of storage on October 14, 2014.

During grading, all bulbs from each plot were counted to determine plant population. During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading. Marketable yield consists of No.1 bulbs larger than 2¼ inches.

At harvest, bulbs from one border bed in each plot were rated for single centers. Twenty-five consecutive onions ranging in diameter from 3½ to 4¼ inches were rated. The onions were cut equatorially through the bulb middle and separated into single-centered (bullet) and multiple-centered bulbs. The multiple-centered bulbs had the long axis of the inside diameter of the first single ring measured. These multiple-centered onions were ranked according to the diameter of the first single ring: small had diameters less than 1½ inches, medium had diameters from 1½ to 2¼ inches, and large had diameters greater than 2¼ inches. Onions were considered "functionally single centered" for processing if they were single centered or had a small multiple center.

Treatment differences in single- and multiple-center bulb ratings, maturity, bolting, IYSV severity, and bulb yield, grade, and decomposition were compared using protected analysis of variance. The plant population in each plot was treated as a covariate. Means separation was determined using Fisher's least significant difference test at the 5% probability level, LSD (0.05).

Results

Onions grew well from planting through early August.

Through tissue analyses conducted during the season and using the nutrient sufficiency ranges (Table 2), the onions required nutrient amendments during the growing season (Table 3). Until the middle of July, it was difficult to maintain root nitrates within the sufficient range. It was difficult to maintain root K in the sufficient range all season.

Onion yields averaged 1,188 cwt/acre or 59.4 tons/acre. No effects of Kelpak or Dominate were observed. There was no significant difference in bulb single centeredness, maturity, or bolting between treatments (Table 4). There was no significant difference in any onion yield category between treatments (Table 5). None of the yield or quality variables were affected by plant population as a covariate. The low coefficients of variation for total yield and marketable yield indicate a low degree of error in the current trial (Table 5).

Acknowledgements

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References

Shock, C.C., E. Feibert, L. Jensen, and J. Klauzer. 2010. Successful onion irrigation scheduling, Sustainable Agriculture Techniques. Oregon State University Extension Service, Corvallis. SR 1097.

Shock, C.C., R. Flock, E. Feibert, C.A. Shock and J. Klauzer. 2013a. Drip irrigation guide for onion growers. Oregon State University Extension Service EM 8901.

Shock, C.C., F-X. Wang, R. Flock, E. Feibert, C.A. Shock, A. Pereira, and L. Jensen. 2013b. Irrigation monitoring using soil water tension. Oregon State University Extension Service EM 8900.

Table 2. Onion root tissue analyses from the check treatment of the Kelpak and Dominate trial, Malheur Experiment Station, Oregon State University,Ontario, OR, 2014.

		4-Jun	24-Jun	1-Jul	15-Jul	22-Jul	29-Jul
NO_3-N (ppm)	Sufficiency range	8239	5020	4411	3193	2584	1975
NO_3-N (ppm)		308	2098	1384	3147	4523	3223
Nutrient	Sufficiency range	4-Jun	24-Jun	1-Jul	15-Jul	22-Jul	29-Jul
P (%)	0.32 - 0.7	0.4	0.4	0.8	0.5	0.7	0.4
K (%)	2.7 - 6	2.8	2.2	2.1	3.6	2.2	1.4
S (%)	0.24 - 0.85	1.0	0.8	0.8	0.3	1.6	1.0
Ca (%)	0.4 - 1.2	0.5	0.7	0.4	1.6	1.0	0.9
Mg (%)	0.3 - 0.6	0.4	0.5	0.4	0.6	0.5	0.4
Zn (ppm)	25 - 50	35	41	30	9	25	13
Mn (ppm)	35 - 100	164	227	130	62	94	94
Cu (ppm)	6 - 20	12	17	12	8	9	5
Fe (ppm)	60 - 250	4615		2288	1265		
B (ppm)	19 - 60	19	35	22	28	25	18

Table 3. Nutrients applied to onions through the drip irrigation system in the Kelpak and Dominate trial, Malheur Experiment Station, Oregon State University, Ontario, OR 2014.

Date	N	K	S	B	Zn	Cu
	---------- lbs/acre ----------					
19-May	20					
30-May	20					
5-Jun	40					
13-Jun	40					
24-Jun	20					
25-Jun		10				
3-Jul	20	20				
11-Jul	25		10	0.2	0.3	
24-Jul		10			0.3	
30-Jul		10		0.2	0.3	0.2
total	185	50	10	0.4	0.9	0.2

Table 4. Single- and multiple-center bulb ratings, maturity, bolting, and IYSV severity. Single-center ratings were taken at harvest. Maturity, bolting, and IYSV ratings were measured on August 21. Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.

	Application timing, (# of leaves)			Multiple center			Single center		Maturity August 21			
Treatment	May 8 (1-2)	May 30 (4)	June 11 (6)	large	medium	small	functional[a]	single	tops down	leaf dryness	Bolting	IYSV
							%					0-5
1	Check			4.0	9.7	14.3	86.3	72.0	67.1	30.0	10.8	1.1
2	Kelpak		Dominate	5.1	7.4	18.3	87.4	69.1	74.3	28.6	8.1	1.1
3		Kelpak	Dominate	2.9	7.4	12.6	89.7	77.1	72.9	30.0	8.5	1.1
4	Kelpak	Kelpak	Dominate	2.3	10.3	20.0	87.4	67.4	68.6	30.0	9.4	1.0
Average				3.6	8.7	16.3	87.7	71.4	70.7	29.6	9.2	1.1
LSD (0.05)				NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Yield and grade performance of onions treated with Kelpak and Dominate harvested September 16 and graded on October 14, 2014, Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.

	Application timing, (# of leaves)				Marketable yield by grade								Bulb counts	
Treatment	May 8 (1-2)	May 30 (4)	June 11 (6)	Total yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	No. 2s	Total rot	>4¼ in	Plant population
				cwt/acre								% of total yield	#/50 lb	plants/acre
1	Check			1184.3	1164.4	67.7	371.5	671.9	53.3	14.6	0.0	0.5	31.9	143,667
2	Kelpak		Dominate	1191.7	1170.5	59.3	347.2	702.7	61.3	14.8	0.0	0.6	31.5	147,061
3		Kelpak	Dominate	1192.5	1171.9	51.6	340.6	726.0	53.7	15.5	0.0	0.4	32.4	146,544
4	Kelpak	Kelpak	Dominate	1184.2	1158.7	56.4	323.3	715.8	63.2	17.8	0.0	0.7	32.3	145,511
Average				1188.2	1166.3	58.7	345.7	704.1	57.9	15.7	0.0	0.5	32.0	145,696
Coef. Var.				5.8	6.1	42.0	21.0	11.0	31.0	45.1	0.0	105.0	6.0	8.0
LSD (0.05)				NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS