



CORN AND SOYBEAN NUTRIENT ACCUMULATIONS GROWN ON A CONTROLLED DRAINAGE/IRRIGATION SYSTEM.

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ABSTRACT

Corn and soybean nutrient accumulations were determined using tissue analysis and biomass estimates. Total corn nutrient uptake (lbs/acre) by element are N (290), P(55), K(158), Mg(27), Ca(72), S(24), Fe(1.1), Mn(1), B(0.1), Cu(0.2), Zn(0.6). Total soybean nutrient uptake (lbs/acre) by element are N (421), P(48), K(205), Mg(45), Ca(138), S(31), Fe(1), Mn(0.6), B(0.5), Cu(0.2), Zn(0.4). Based on total plant uptake, the percentages of each nutrient in the cob, stem, ear leaves, grain, tassel, shank and axial leaves are illustrated. Approximately 50% of the N is partitioned into the corn grain and 82% of the N is partitioned in the soybean grain.

Corn and Soybean Design

Corn and Soybeans were planted in the spring of 2008 on 0.77 meter (30 inch) row-spacing for the corn and 0.38 meter (15 inch) row-spacing for the soybeans. Phosphorus and K fertilization was based on grid soil sampling, whereas the N rates were 120 lbs of N as liquid N (32% N-solution) pre-plant, with the remainder of the nitrogen applied approximately four to six weeks post-planting based on a pre-side dress nitrate soil test, stand density and yield goal. Tissue testing (N, P, K, Ca, Mg, S, Na, Al, Fe, Mn, Zn, B, and Cu) and plant biomass accumulation were used to assess nutrient uptake patterns and were conducted mid-season and prior to harvest. Plant organ sampling included total biomass and nutrient concentrations associated with stem (culm), leaf and seed, with total plant uptake and biomass accumulation the summation of the plant organs. Biomass sampling involved randomly selecting four plants from each replicate. Manual separation of the plant parts was followed by drying at 70°C for two days and weighing. Population estimates were performed by counting all plants in a 10 foot row-length, which was replicated for a total of five times for each replicate.

Yield estimates were obtained for each replicate to determine the average yield. The corn was harvested from all plants within a 10 foot row-length. The number of ears was counted from each plot and the grain husked and shelled (using a hand sheller) and weighed. The average yields were determined by extrapolating the weights to that of an acre (bushels per acre). Statistical analysis was performed using a two-way analysis of variance, based on planting density and whether the plots were harvested from over the tiles or between. The soybean yield estimates were conducted identically, except 5 foot of row-length was employed for sampling.

Corn Harvest Biomass and Nutrient Accumulation Patterns Biomass Accumulation

Plant height and the number of mature leaves per plant were not significantly different because of plant population (Table 1). The greatest plant biomass was associated with the smallest plant population and the least biomass was associated with the highest plant population; however, the differences were not significant

Table 1. Black layer corn growth and yield components for 2008.

Population: Plants/Acre	Height cm	# Leaves/Plant	Total Biomass g/plant
25,000	342	12.5	367
27,000	338	13.5	344
29,000	338	12.3	276
31,000	337	13.0	325
33,000	336	13.8	250

The percentage biomass distribution among the plant components (ear leaves, leaves (axial leaves or stem leaves), culm, cob, shank, tassel and grain) show that the greatest biomass accumulations in the grain, followed closely by the culm and leaves (Figure 1)

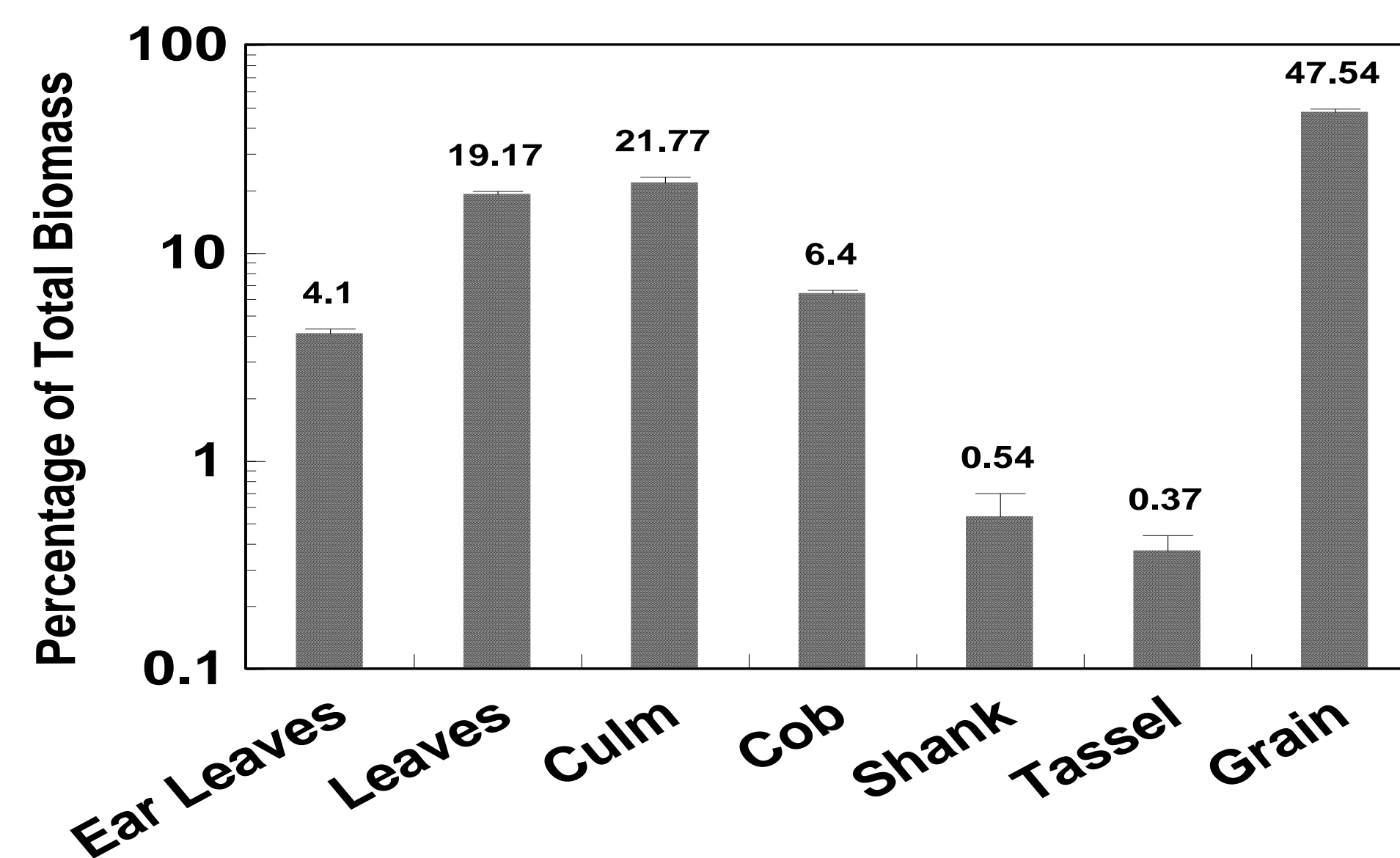


Figure 1. The percentage distribution of biomass components.

Total Nutrient Uptake

The total partitioning of the nutrients at maturity indicate that the grain component is the largest reservoir for N, P, S, and Zn, whereas the leaves are the largest reservoir for K, Mg, Ca, Fe, Mn, B, and Cu. The stem is also an important reservoir for N, K, Mg, Ca, and Fe. Harvest of the grain will remove the majority of the total plant uptake of N and P and approximate half of the S.

Table 2. Estimated total nutrient uptake by corn at black layer formation in lbs/acre (2008).

Plant Part	N	P	K	Mg	Ca	S	Fe	Mn	B	Cu	Zn
Cob	10	1.0	7.4	0.4	1.2	0.7	0.032	0.008	0.0005	0.006	0.021
Stem	28	3.7	23.0	6.5	16.1	2.3	0.331	0.069	0.018	0.023	0.074
Ear Leaf	5	1.0	10.7	0.7	1.7	0.4	0.027	0.042	0.004	0.003	0.022
Grain	142	32.2	47.3	9.1	1.0	11.1	0.181	0.50	0.020	0.030	0.231
Tassel	1	0.2	1.8	0.1	0.4	0.1	0.006	0.015	0.003	0.001	0.004
Shank	1	0.1	3.3	0.02	0.1	0.05	0.005	0.001	0.001	0.002	0.002
Leaves	103	16.9	64.1	10.6	51.1	9.2	0.487	0.819	0.053	0.081	0.219
Total	290	55	158	27	72	24	1.1	1	0.1	0.2	0.6

Estimated using bulk samples homogenized across all populations.

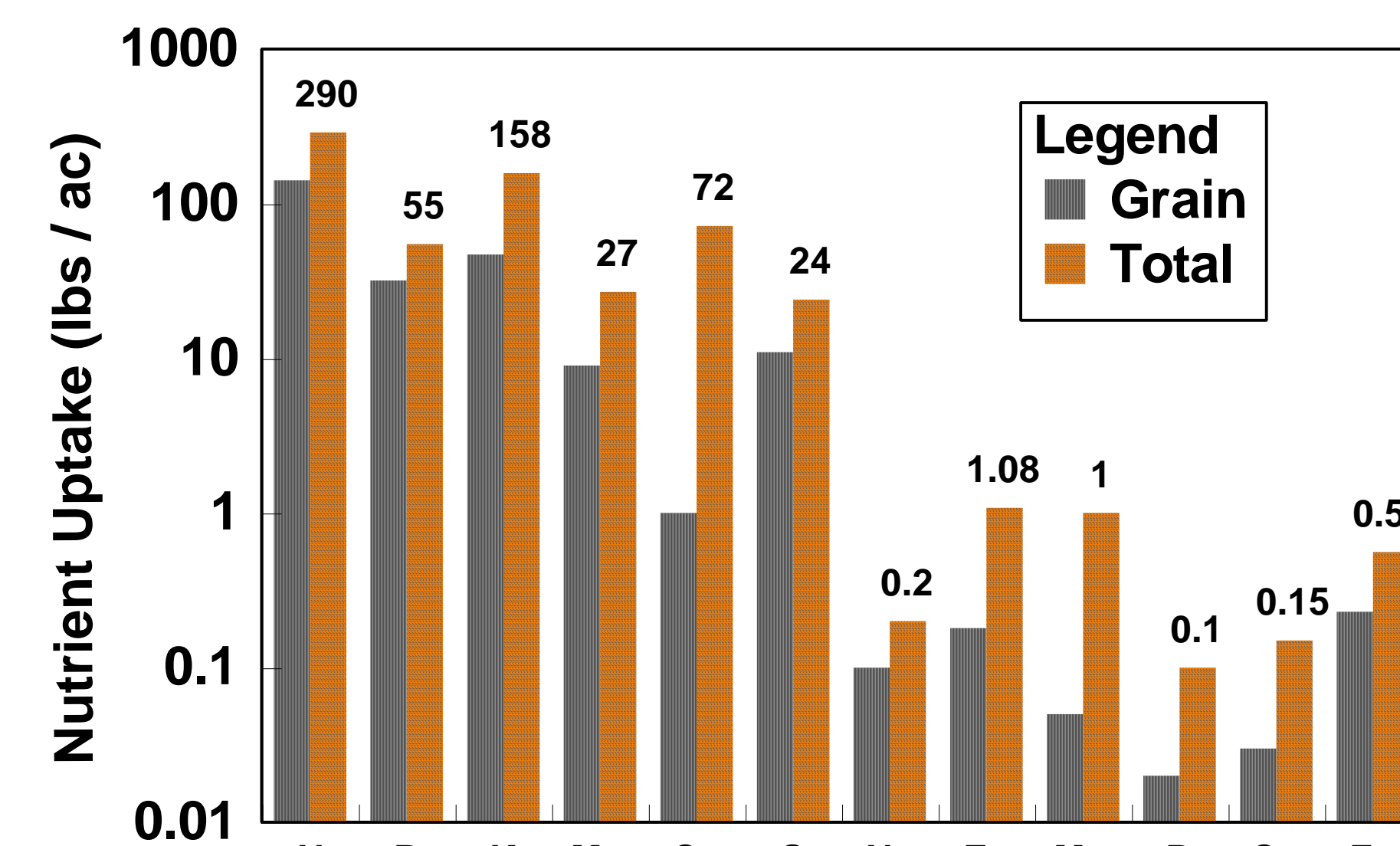


Figure 2. Nutrient uptake in corn

Soybean Harvest Biomass and Nutrient Accumulation Patterns Biomass Accumulation at Maturity

The final soybean biomass distribution shows that the Pod component (seed and modified leaves) has the greatest mass; however, if one just considers vegetation and seed weight, then these two components have approximately equivalent mass distributions (Figure 3).

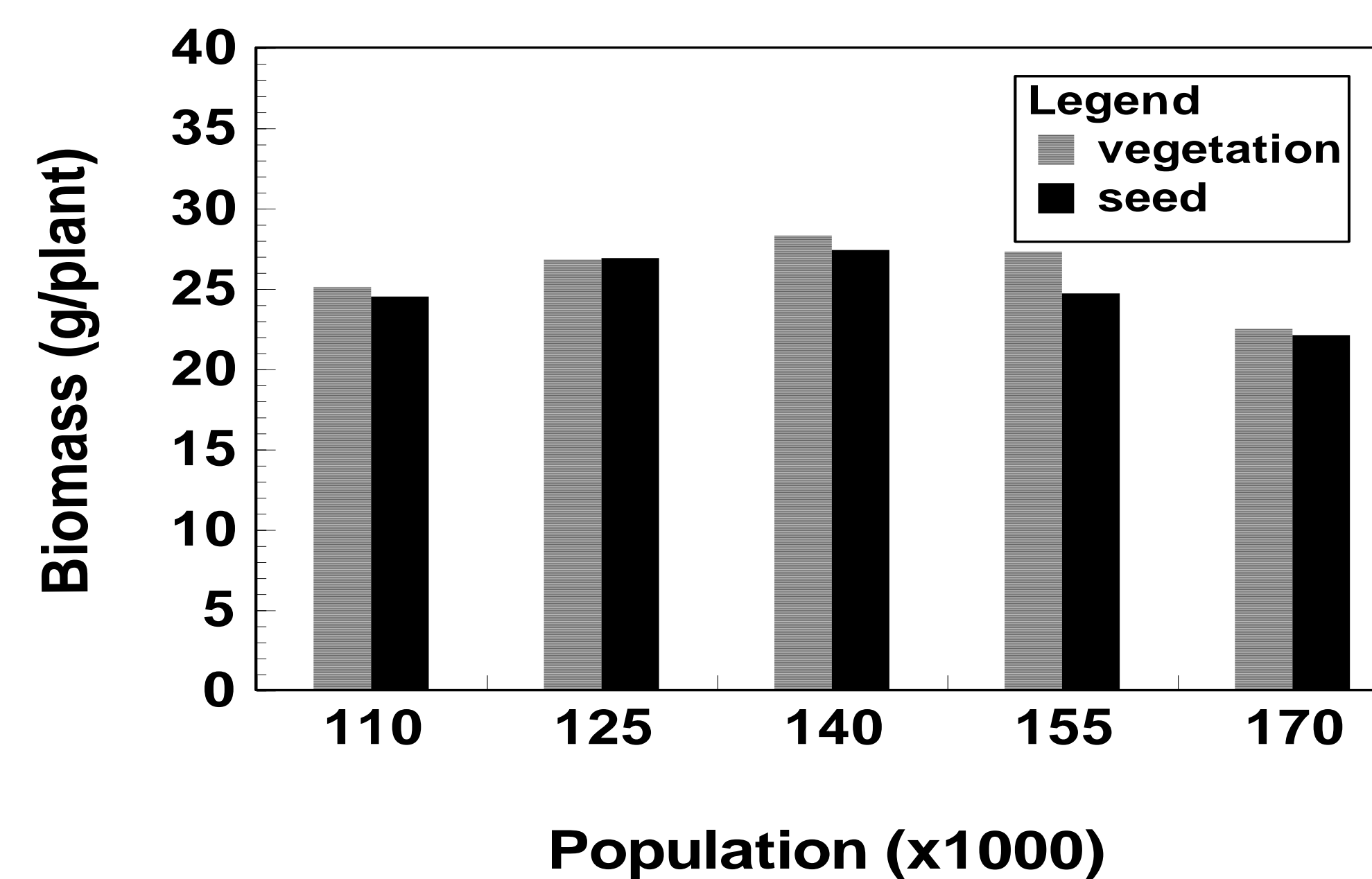


Figure 3. Biomass distribution in the mature soybean plant

Total Nutrient Uptake at Maturity

Total nutrient uptake distributions reflect the interaction of biomass and tissue concentration. The seed component demonstrated the largest reservoir for N, P, K, S, Fe, B, Cu and Zn. The stem-leaf component had the greatest uptake levels of Ca, Mg and Mn.

Table 3. Total soybean nutrient uptake at maturity in lbs/acre (2008).

Plant Part	N	P	K	Mg	Ca	S	Fe	Mn	B	Cu	Zn
Seed											
mean	357	37	127	18	27	23	0.64	0.25	0.29	0.12	0.29
std	56	7	27	4	6	5	0.08	0.07	0.05	0.2	0.06
Pod Case											
mean	15	2.4	31	7	18	1.4	0.5	0.04	0.04	0.01	0.02
std	4	0.8	6	1	4	0.4	0.03	0.03	0.02	0	0
Stem-Leaf											
mean	49	9	46	20	94	7	0.33	0.31	0.15	0.04	0.08
std	12	2	15	8	16	2	0.09	0.11	0.02	0.01	0.02
Total	421	48	205	45	138	31	1	0.6	0.5	0.2	0.4
% seed	85	77	62	39	19	74	63	42	60	71	74

%seed is the percentage of the nutrient in the harvestable seed.

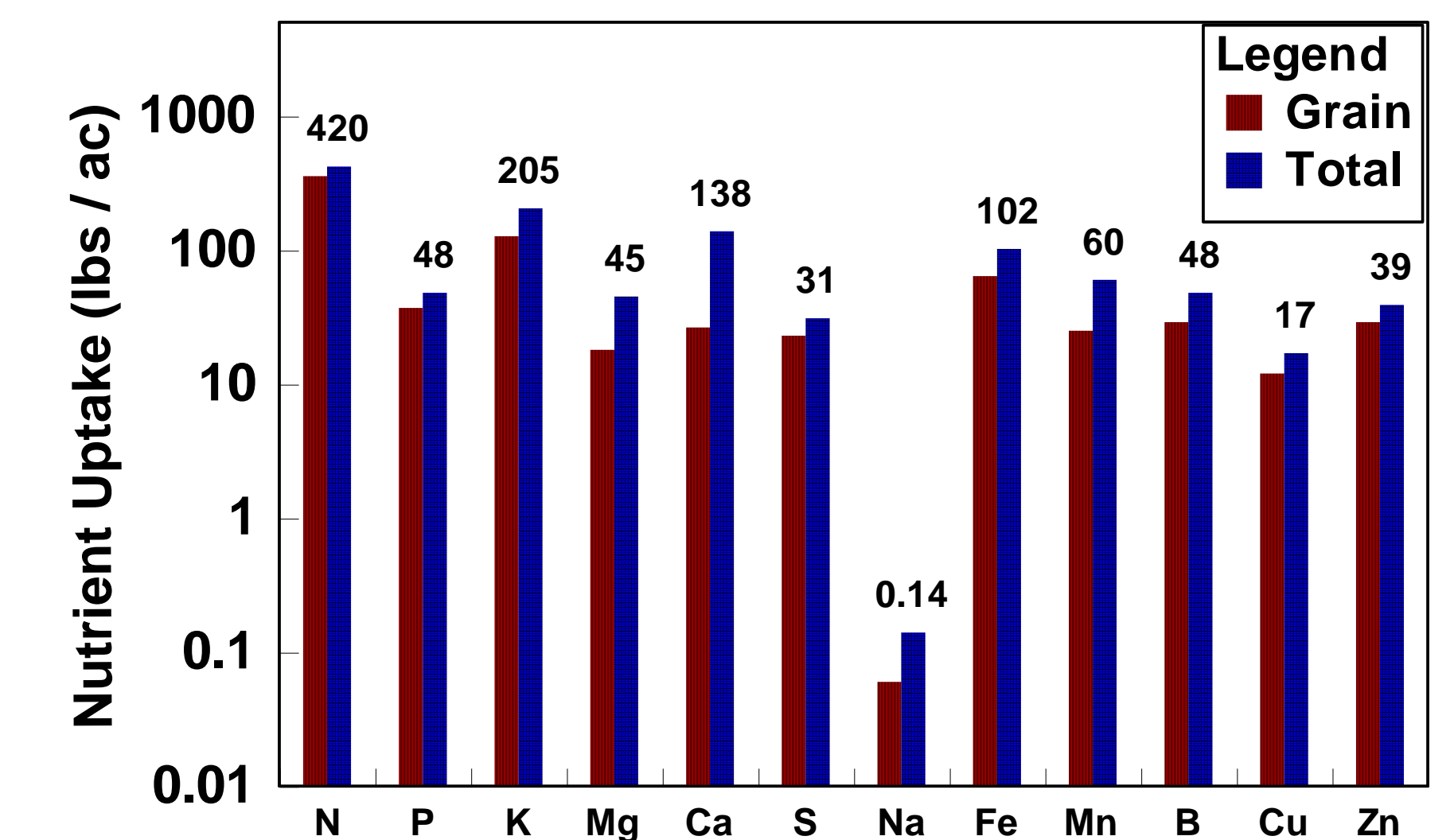


Figure 4. Nutrient uptake in soybean

Corn and Soybean Harvest Yield

The yields of corn averaged 226 bu/acre (15.5 % moisture basis) and soybeans yield an average of 82 bu/acre (Table 4).

Table 4. Corn and Soybean yields (Bu/acre)

Corn Population	Average	Soybean Population	Average
25,000	229	110,000	76
27,000	227	125,000	95
29,000	224	140,000	74
31,000	217	155,000	75
33,000	232	170,000	89
Mean	226		82

No significant differences (P=0.05) involving population.

