UNIVERSITY OF KWAZULU-NATAL
SCHOOL OF AGRICULTURAL, EARTH & ENVIRONMENTAL SCIENCES
DISCIPLINE OF CROP SCIENCE
FINAL EXAMINATION: JUNE 2014
SUBJECT, COURSE & CODE: FIELD CROPS MANAGEMENT, AGPS 305

DURATION: 3 HOURS **TOTAL MARKS: 180**

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External Examiner: Dr Yacob Beletse

NOTE: THIS PAPER CONSISTS OF FOUR (4) PAGES. PLEASE SEE THAT YOU HAVE THEM ALL. QUESTION 8 IS COMPULSORY. IN ADDTION TO IT, ANSWER ANY OTHER FOUR (4) QUESTIONS.

QUESTION 1 [30]

Discuss crop classification and its importance in agronomy.

QUESTION 2 [30]

Wheat yield is negatively affected by molybdenum (Mo) deficiency. A fertiliser company has formulated a Mo spray for wheat, called MolySpray. They argue that the formulation is more effective when applied before flowering. The argument needs to be tested in an experiment to compare three levels of Mo (10 ppm, 30 ppm and 50 ppm) and a distilled water control (0 ppm), at emergence (E), three weeks after emergence (3WAE), six weeks after emergence (6WAE), at tasselling (flowering) (T) and two weeks after flowering (2WAT).

(a) Present a statistical design and a field layout for a completely randomised block experiment that is replicated three times. (10)
(b) Present a skeleton ANOVA table with formulae. (5)
(c) The mass of seeds per plant (g) was counted on each plant (x) in a random sample of one of the treatments and presented in a frequency table (Table 1).

Table 1. Frequency table

x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
g	10	14	12	9	9	10	11	9	10	9	10	12	9	10	9	14	10	9	10	13

(i) Calculate the sample mean. (3)
(ii) Calculate the median. (3)
(iii) Calculate the sample variance (3)
(iv) Calculate the sample standard deviation (3)
(v) Speculate on the nature of data distribution (3)

QUESTION 3 [30]

(a) Given the combined fertiliser 2:3:2 (22) and straight fertiliser Limestone Ammonium Nitrate (LAN) with 28% N, calculate how much of each fertiliser is needed to grow a hectare of a crop where 200 kg/ha N, 90 kg/ha P and 60 kg/ha K must be applied. (10)
(b) Given the soil analysis results shown in Table 2, calculate the amount of 80% pure lime required to grow a crop that tolerates 16% acid saturation and explain what type of lime must be used. (10)

Table 2. Soil analysis data

	pH	Clay	Humus	Na	K	Ca	Mg	Al+H	Total cations
mg L^{-1}				29	74	98	48	-	-
$cmol_c$ L^{-1}					-	-	-	5.3	-
	?	15%	6.3%						
Molar mass	-	-	-	23	39	40	24	-	-

(c) Estimate soil N content and total CEC? Note clay type has 115 $cmol_c$ L^{-1}CEC; Humus has 215 $cmol_c$ L^{-1} CEC. (5)

(d) Calculate the sodium adsorption ratio of the soil and comment on (i) its sodicity/alkalinity and (ii) possible pH level. (5)

QUESTION 4 [30]

Discuss tillage as a field crop management system. Your discussion must compare and contrast the different tillage types.

QUESTION 5 [30]

(a) Explain and illustrate greenhouse effect and elaborate on its relationship to climate change. (25)

(b) Explain Figure 1 (5)

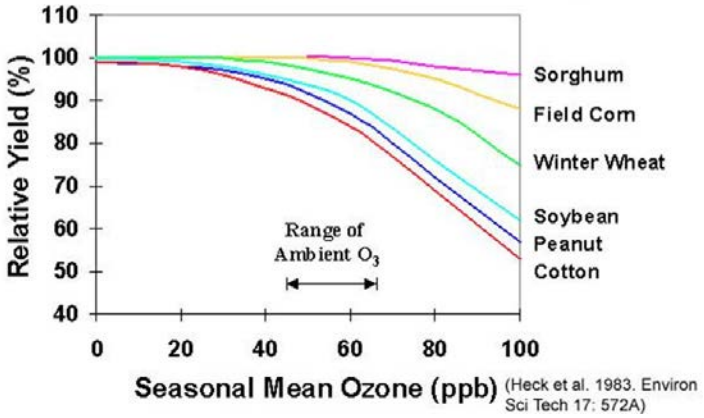

Figure 1

QESTION 6 [30]

(a) Use Appendix 1 to answer this question. Provide a comparison of crop performance at three sites (A, B and C) characterized by mean annual rainfall (A= 1200 mm, B = 800 mm, C = 600 mm) heat units (A = 1800, B = 2000, C = 2400) soil (A= well drained loam, 120 cm deep; B = soft plinthic clay, 50 cm deep, C = well drained sand, 1 m deep) and management (A = excellent, B = good, C = good). Briefly discuss your results. (15)

(b) Management of water, nutrients and light resources is important for successful plant growth and excellent yield. Explain and illustrate the concept of biomass accumulation and associated growth patterns in annual crops. (15)

QUESTION 7 [30]

Discuss the concept of sustainable agriculture and clearly illustrate your understanding of integrated crop management.

QUESTION 8 [60]

(a) Explain how soil water content can be determined and use a labelled illustration (only) to show that you understand the concept of soil water availability. (10)

(b) Soil water content cannot be used to estimate the amount of water available for crop growth consistently without considering soil type. Explain this statement using an illustration. (10)

(c) Use Figure 2 below to answer this question. Assume you have a sprinkler system operating uniformly and applying 7 mm per hour. (Note that sprinkler output needs to be confirmed during sprinkler testing.). Estimate the amount of irrigation water and associated runtime required for the crop with a root diameter at about1 mm, 7 mm, 18 mm, 24 mm and 32 mm, respectively if the weather station tells us the evaporation the previous day was 6 mm, 6.5 mm, 8.2 mm, 6.6 mm and 6.8 mm for each case, respectively. (15)

(d) Use a hypothetical annual crop to illustrate and explain how water loss in agriculture occurs over a growing season? (10)

(e) Transplanting has become the major establishment method of field vegetables. Elaborate this statement by (i) identifying vegetables crops that are typically transplanted (name 4 crops) and those that should not be transplanted (name 1 crop); (ii) describing the types of containers used for raising transplants; and discuss the advantages/ disadvantages of using one versus another containers (15)

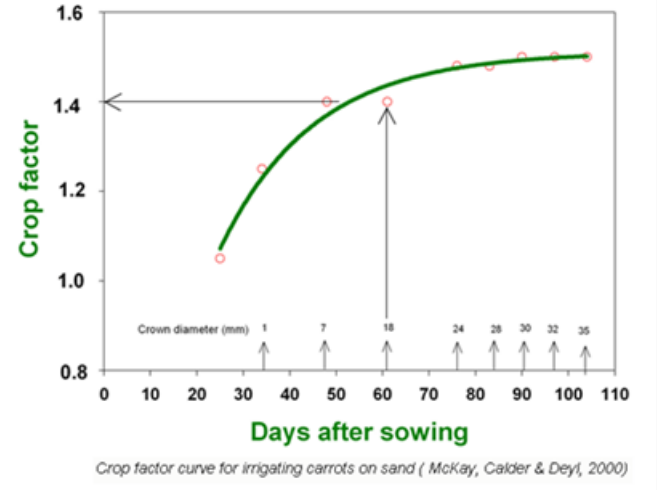

Figure 2

APPENDIX 1

TABLE 1. Relationships of mean annual rainfall, seasonal rainfall, and effective rainfall factor

Mean annual rainfall (mm)	Seasonal rainfall October to March (mm)	Effective rainfall factor
1 400	1 120	0,6
1 300	1 040	0,7
1 200	960	0,8
1 100	880	0,9
1 000	800	1,0
900	720	0,9
800	640	0,8
700	560	0,7
600	480	0,6

TABLE 2. Maize grain yield in relationship to heat units and rainfall

Heat units (October to March)	Maize (tons per ha per 100 mm effective rainfall)
2 400	1,0
2 200	1,2
2 000	1,3
1 800	1,4
1 600	1,3
1 500	1,2
1 400	1,1
1 300	1,0
1 200	0,9
1 100	0,8

TABLE 3. Soil factor to be applied to calculate crop yield according to rainfall, soil depth and texture

Mean annual rainfall	Rooting depth (mm)	Well-drained soils			Soft plinthic soils		
		Sand < 15% clay	Loam 15-35% clay	Clay >35% clay	Sand < 15% clay	Loam 15 – 35% clay	Clay >35% clay
>775	1 000	0,9	1,0	1,1	0,9	1,0	1,1
	750	0,8	0,9	1,0	0,7	0,8	0,9
	500	0,7	0,8	0,9	0,6	0,7	0,8
<775	1 000	0,8	1,0	0,9	1,0	1,1	1,0
	750	0,7	0,8	0,7	0,9	1,0	0,9
	500	0,5	0,7	0,6	0,8	0,9	0,8

TABLE 4. Influence of the level of management on yields, expressed as an adjustment factor

Management level	Factor
Excellent Good Fair	1,0 0,8 0,7
Poor	0,5