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APPENDICES

Appendix A

1. Analysis of chemical composition of serum

1.1 Analysis of Ammonium content by the Phenolhypochlorite Method (Solorzano, 1969)

Reagent

1. Phenol-alcohol solution: Dissolve 10 g of reagent grade phenol in 100 mL of 95% v/v ethyl alcohol.

2. Sodium nitroprusside 0.5%: Dissolve 1 g of sodium nitroprusside in 200 mL of water. Store in an amber bottle for not more than one month.

3. Alkaline solution: Dissolve 100 g of trisodium citrate and 5 g of sodium hydroxide in 500 mL of distilled water.

4. Sodium hypochlorite solution. Use a solution of commercial hypochlorite (e.g., Chlorox) which should be at least 1.5 N. The solution slowly decomposes and its strength should be checked periodically.

5. Oxidizing solution: Mix 100 mL of sodium citrate solution and 25 mL of hypochlorite solution and use the same day.

6. Standard solution: Dissolve 1.32 g of $(NH_4)_2SO_4$ in distilled waster and dilute to 1,000 mL. (1mL=10 μmole NH_4-N)

Procedure

Add 0.4 mL of phenol solution, 0.4 mL of sodium nitroprusside solution, and 1 mL of oxidizing reagent to 10 mL of sample, mixing thoroughly after each addition. The color is allowed to develop at room temperature (22-27°C) for 1 hr and the absorbance recorded at 640 nm. in a spectrophotometer.

Calculation

$$NH_4\text{-N (mg/L)} = \mu\text{mole/L (reading) x dilution factor x } 0.036$$

1.2 Analysis of Total Kjeldahl Nitrogen (Kjeldahl method)(Tassanee, 1977)

Reagent

1. Concentrated sulfuric acid (H_2SO_4)
2. Catalyst mixture (anhydrous): K_2SO_4: $CuSO_4.5H_2O$ in the proportion of 10:1
3. Boric acid (2% v/v): Weigh 20 g boric acid (H_3BO_3) into a 1,000 mL volumetric flask and bring to volume with water.
4. Sodium Hydroxide (32% v/v): Weigh 320 g Sodium hydroxide (NaOH) into a 1,000 mL volumetric flask and bring to volume with water.
5. Standard Sulfuric acid (0.1 N): Dilute 2.8 mL of conc.sulfuric acid with distilled water and bring to volume 1,000 mL. Standardize the exactly concentration with 0.1 N Sodium carbonate.
6. Mixed indicator: Weigh 0.066 g bromocresol green and 0.033 g methyl red in 100 mL of 95% ethanol.

Procedure

Digestion: Weigh 3 g of catalyst mixture into the Kjeldahl flask, add 10 mL of serum and 20 mL of conc. Sulfuric acid. Heat the Kjeldahl flask over a flame to digest the sample until it clear.

Distillation: Add 40 mL of distilled water and 85 mL 32%(w/v) Sodium hydroxide solution to the cool sample and place into the distillation apparatus. Prepare a 250 mL Erlenmeyer flask containing 60 mL of 2% boric acid and five drops of mixed indicator. Place the flask under the condenser of the distillation apparatus. Distill the sample for 3 minutes.

Titration: Titrate the solution of boric acid and mixed indicator containing the "distilled off" ammonia with the 0.1 N standardized sulfuric acid.

Calculation

$$\% N = \frac{(\text{sample titer} - \text{blank titer}) \times N \text{ of } H_2SO_4 \times 14 \times 100}{\text{Sample volume (mL)} \times 1000}$$

1.3 Analysis of Phosphate (Strickland and Parsons, 1972)

Reagent

1. Ammonium paramolybdate solution: Dissolve 15 g Ammonium paramolybdate $(NH_4)_6\ Mo_7O_{24}.4H_2O$ in distilled water 500 mL.
2. Sulfuric acid solution: Dilute 140 mL conc. Sulfuric acid in 900 mL distilled water.
3. Ascorbic acid solution: Dissolve 27 g ascorbic acid in 500 mL of distilled water.
4. Potassium antimonyl-tartrate solution: Dissolve 0.34 g Potassium antimonyl-tartrate in 250 mL distilled water.
5. Mixed reagent: Mix 100 mL of Ammonium paramolybdate solution, 250 mL Sulfuric acid solution, 100 mL Ascorbic acid solution and 50 mL Potassium antimonyl-tartrate solution thoroughly, used daily.
6. Standard solution: Dissolve 0.816 g anhydrous Potassium dihydrogen phosphate (KH_2PO_4) in 1000 mL distilled water (1 mL = 6 μg atom P)

Procedure

Measure 10 mL sample and add 1 mL of mixed reagent. Mixed thoroughly and allow to stand for 5 minute and measure turbidity at 885 nm. Estimate PO_4^{2-} concentration in sample by comparing absorbance reading with a calibration curve prepared by carrying PO_4^{2-} standards through the entire procedure. Prepare standard at 0 to 60 μg/L PO_4^{2-} range.

Calculation

$$PO_4^{2-}\text{-P (ppm)} = \mu g/L \text{ (reading)} \times \text{dilution factor} \times 10^{-3}$$

1.4 Analysis of Sulfate (Turbidimetric Method)

Reagent

1. Barium chloride, $BaCl_2$ crystal, 20 to 30 mesh.
2. Standard sulfate solution: Dissolve 0.1479 g anhydrous Na_2SO_4 in distilled water and dilute to 1000 mL.

3. Conditioning reagent: Mix 50 mL glycerol with the solution of 30 mL conc. Hydrochloric acid, 300 mL distilled water, 100 mL 95%ethanol and 75 g of sodium chloride.

Procedure

1. Formation of barium sulfate turbidity: Measure 100 mL sample into a 125 mL erlenmeyer flask. Add 5 mL conditioning reagent and mix in stirring apparatus. While stirring, add 3 g of $BaCl_2$ crystal and begin timing immediately. Stir for 60±2 s at constant period.

2. Measurement of barium sulfate turbidity: After stirring period has ended, pour solution into absorption cell of photometer and measure turbidity at 5±0.5 min.

3. Preparation of calibration curve: Estimate SO_4^{2-} concentration in sample by comparing turbidity reading with a calibration curve prepared by carrying SO_4^{2-} standards through the entire procedure. Space standard at 5 mg/L increments in the 0 to 40 mg/L SO_4^{2-} range.

4. Correction for sample color and turbidity: Correct for sample color and turbidity by running blanks to which $BaCl_2$ is not added.

Calculation

$$SO_4^{2-}(g/L) = mg/L(reading) \times dilution\ factor \times 10^{-3}$$

1.5 Analysis of K, Ca, Mg, Zn, Fe, Mn and Cu by AAS

Digestion of serum sample

Reagent

1. Concentrated nitric acid (HNO_3)
2. Hydrochloric acid: 1:1 v/v in distilled water

Procedure

Add 50 mL of serum into a digestion tube. Add 3 mL of conc.HNO_3 and allow to predigest under a fume hood for at least 15 minutes. Gradually increase the heat until the mixture becomes clear yellow about 60 minutes. Cool and add 5 mL of conc. HNO_3. Heat the sample until the mixture remains 5 mL. Cool and add 10 mL of HCl (1:1). Continue to heat about 15 minutes. Cool and filter through filter paper and dilute to 100 mL with distilled water.

Analysis: K, Ca, Mg, Zn, Fe, Mn and Cu in the digested sample are determined by AAS.

2. Analysis of chemical composition of plant

2.1 Analysis of Total Kjeldahl Nitrogen (Kjeldahl method) (Department of Agriculture, 1993)

Reagent

1. Concentrated sulfuric acid (H_2SO_4)
2. Catalyst mixture (anhydrous): K_2SO_4 : $CuSO_4$: Se metal in the proportion of 100:10:1
3. Boric acid (2% v/v): Weigh 20 g boric acid (H_3BO_3) into a 1,000 mL volumetric flask and bring to volume with water.
4. Sodium Hydroxide (32% v/v) : Weigh 320 g Sodium Hydroxide (NaOH) into a 1,000 mL volumetric flask and bring to volume with water.
5. Standard Sulfuric acid (0.02 N) : Dilute 1N sulfuric acid with distilled water and bring to volume 1,000 mL. Standardize the exactly concentration with 0.05 N Sodium carbonate.

6. Mixed indicator: Weigh 0.066 g bromocresol green and 0.033 g methyl red in 100 mL 95% ethanol.

Procedure

Digestion: Weigh 1.1 g of catalyst mixture into the Kjeldahl flask, add 0.2000 g of plant sample and 10 mL of conc. Sulfuric acid. Heat the Kjeldahl flask over a flame to digest the sample until it clear.

Distillation: Add 30 mL of distilled water and 45 mL of 32% (w/v) Sodium hydroxide solution to the cool sample and place into the distillation apparatus. Prepare a 250 mL Erlenmeyer flask containing 60 mL of 2% boric acid and five drops of mixed indicator. Place the flask under the condenser of the distillation apparatus. Distill the sample for 3 minutes.

Titration: Titrate the solution of boric acid and mixed indicator containing the "distilled off" ammonia with the 0.02 N standardized sulfuric acid.

Calculation

$$\% N = \frac{(\text{sample titer} - \text{blank titer}) \times N \text{ of } H_2SO_4 \times 14 \times 100}{\text{Sample weight (g)} \times 1000}$$

2.2 Analysis of phosphorus, potassium, sulfur, calcium, magnesium, iron, manganese, copper, and zinc in plant tissue (Department of Agriculture, 1993)

Digestion of plant sample

Reagent

1. Acid mixture: Prepare a mixture containing HNO_3 and $HClO_4$ in ratio 2:1 v/v

Procedure

Put 0.5 g of dried, ground, plant material into a digestion tube. Add 10 mL of acid mixture and allow predigesting under a fume hood for at least 2 hours. Gradually increase the heat until the mixture become clear. Cool and filter through filter paper and dilute to 100 mL with distilled water. Allow standing for 24 hours. Collect the clear filtrate for element analysis.

Analysis: K, Ca, Mg, Cu, Fe, Mn, and Zn in the digested sample are determined by AAS. Phosphorus and sulfur are determined by the method described in 2.3 and 2.4, respectively.

2.3 Analysis of phosphorus (Department of Agriculture, 1993)

Reagent

1. Vanadate reagent: Dissolve 0.5 g of ammonium vanadate (NH_4VO_3) in 100 mL of boiling water. Let it cool and add 80 mL of 70% $HClO_4$. Dilute to 1,000 mL with distilled water.

2. Molybdate reagent: Weigh 12.5 g of ammonium molybdate [$(NH_4)_6Mo_7O_{24}.4H_2O$)] into a 1,000 mL flask and bring to volume with water.

3. Stock standard solution (1,000 ppm P): Weigh potassium dihidrogen phosphate (KH_2PO_4) 4.393 g into a 1,000 mL flask and bring to volume with water.

4. Working standard: Dilute stock standard solution to 0, 5, 10, 15 and 20 ppm into 100 mL flask, add 10 mL of $HClO_4$ to each flask and bring to volume with distilled water.

Procedure

Pipette 3 mL of digested sample (from 2.2) or standard into a test tube. Add 3 mL of vanadate reagent and mix thoroughly. Then add 3 mL of molybdate reagent and mix thoroughly. Let it stand 30 minutes and measure absorbance at 420 nm.

Calculation

$$\%P = \frac{\text{ppm (reading) x dilution factor x 100 x } 10^{-6} \text{ x 100}}{\text{sample weight (g)}}$$

2.4 Analysis of sulfur (Turbidimetric method) (Department of Agriculture, 1993)

Reagent

1. Polyvinyl Alcohol (PVA): Dissolve 2 g of polyvinyl alcohol in 400 mL hot water. Let it cool and bring to volume 1,000 mL with distilled water. Keep the solution refrigerated.

2. Acid mixture: Dilute 50 mL of glacial acetic acid in 800 mL of distilled water then add 20 mL of 10 N HCl , 20 mL of 85% orthophosphoric acid and 6 mL of 1:1,000 H_2SO_4. Bring to 1,000 mL with distilled water. Keep the solution refrigerated.

3. Stock Standard sulfate solution: Dissolve 0.443 g anhydrous Na_2SO_4 in distilled water and dilute to 1000 mL. (100 ppm S)

4. Working Standard: Prepare 0, 2, 5, 8, 10 and 15 ppm S by diluting stock standard sulfate solution.

Procedure

Add 5 mL of the digested sample or standard into a 25 mL flask. Add 5 mL of Polyvinyl Alcohol and mix thoroughly. Add 0.3 g of $BaCl_2$ and stir for 1 minute. Let it stand for 30 seconds and then measure absorbance at 420 nm.

Calculation

$$\%S = \frac{\text{ppm (reading) x dilution factor x 100 mL x } 10^{-6} \text{ x 100}}{\text{sample weight (g)}}$$

3. Analysis of Soil

3.1 Total Nitrogen (Kjeldahl method)(Tassanee, 1977)

Reagent

1. Concentrated sulfuric acid (H_2SO_4)
2. Catalyst mixture (anhydrous): K_2SO_4: $CuSO_4$: Se metal in the proportion of 100:10:1
3. Boric acid (2% v/v): Weigh 20 g boric acid (H_3BO_3) into a 1,000 mL volumetric flask and bring to volume with water.
4. Sodium Hydroxide (32% v/v): Weigh 320 g Sodium Hydroxide (NaOH) into a 1,000 mL volumetric flask and bring to volume with water.
5. Standard Sulfuric acid (0.05 N): Dilute 1N sulfuric acid with distilled water and bring to volume 1,000 mL. Standardize the exactly concentration with 0.05 N Sodium carbonate.
6. Mixed indicator: Weigh 0.066 g bromocresol green and 0.033 g methyl red in 100 mL 95% ethanol.

Procedure

Digestion: Weigh 3.5 g of catalyst mixture into the Kjeldahl flask, add 1.000 g of air dry (0.5 mm) soil and 20 mL of conc. Sulfuric acid. Heat the Kjeldahl flask over a flame to digest the sample until it clear.

Distillation: Add 40 mL of distilled water and 32%(w/v) Sodium hydroxide solution to the cool sample and place into the distillation apparatus. Prepare a 250 mL Erlenmeyer flask containing 60 mL of 2% boric acid and five drops of mixed indicator. Place the flask under the condenser of the distillation apparatus. Distill the sample for 3 minutes.

Titration: Titrate the solution of boric acid and mixed indicator containing the "distilled off" ammonia with the standardized sulfuric acid.

Calculation

$$\% N = \frac{(\text{sample titer} - \text{blank titer}) \times N \text{ of } H_2SO_4 \times 14 \times 100}{\text{Sample weight (g)} \times 1000}$$

3.2 Sulfate in Soil (Soil Analysis Handbook of Reference Methods, 1999)

0.5 M Ammonium acetate-0.25 M Acetic acid extraction

Reagents

1. Extraction Reagent (0.5 M ammonium acetate-0.25 M acetic acid): Weigh 39 g ammonium acetate ($NH_4C_2H_3O_2$) into a 1,000 mL volumetric flask and bring to volume with 0.25 M acetic acid ($HC_2H_3O_2$) (dilute 14.31 glacial $HC_2H_3O_2$ in 1,000 mL water).
2. Seed Solution: Dissolve 0.1087 g potassium sulfate (K_2SO_4) in 500 mL water and add 500 mL conc. Hydrochloric acid (HCl). Stir to bring into solution and slowly add 2.0 g powdered gum acacia with stirring to bring into solution. Keep the prepared solution refrigerated.
3. EDTA Solution (0.02 M): Weigh 5.84 g ethylenediaminetetraacetic acid (H_4EDTA) into a 1,000 mL volumetric flask, add 30 mL conc. Aqueous ammonia (NH_4OH, s.p. = 0.91 g cm^{-3}), and bring to volume with water.
4. Barium Chloride Crystals: Crush barium chloride ($BaCl_2.H_2O$) to pass as 20 to 30 mesh sieve.
5. Charcoal
6. Stock Solution (1,000 mg SL^{-1}): Weigh 5.434 g potassium sulphate (K_2SO_4) into a 1,000 mL volumetric flask in about 400 mL EDTA Solution and bring to volume with EDTA Solution.

Extraction Procedure

Weigh 10 g air-dry < 10-mesh (2 mm) soil into an extraction vessel, pipette 25 mL Extraction Reagent into the flask, and shake for 30 minutes. Add 0.15 g of powdered Charcoal and shake for an additional 3 minutes. Filter and transfer a 10 mL aliquot into another flask.

Analytical Procedure

Measurement: To a 10 mL aliquot, add 1 mL Seed Solution and immediately swirl the contents. Place the flask on magnetic stirrer and add 0.3 g Barium Chloride Crystals. Stir for about 1 minute. Transfer an aliquot to a cuvette and then read the absorbance using a calibrated UV-VIS spectrophotometer at 420 nm.

Calibration and Standards

Standard Series: Pipette 0, 1, 2, 3, 4, and 5 mL Stock Solution into a series of 100 mL volumetric flasks and bring to volume with EDTA Solution. This Standard Series has S concentrations of 0, 10, 20, 30, 40, and 50 mg S L^{-1}, respectively.

Calculation

The SO_4-S content of the soil material, expressed in mg SO_4-S kg^{-1} is determined by multiplying the SO_4-S content in the extractant by 2.5.

3.3 Copper, Iron, Manganese and Zinc in soil (Soil Analysis Handbook of Reference Methods, 1999)

DTPA Extraction

Reagents

1. Extraction reagent (DPTA-diethylenetriaminepentaacetic acid): Weigh 1.96 g DPTA $\{[(HOCOCH_2)_2NCH_2CH_2]_2NCH_2COOH\}$ into a 1,000 mL volumetric flask. Add 14.92 g Triethanolamine (TEA) and bring to volume to approximately 950 mL with water. Add 1.47 g calcium chloride ($CaCl_2.2H_2O$) and bring to 1,000 mL with water while adjusting the pH to exactly 7.3 with 6 N hydrochloric acid (HCl). The final concentration will be 0.005 M DPTA, 0.1 M TEA, and 0.01 M $CaCl_2.2H_2O$.

Procedure

Extraction: Weigh 10 g of air dry (2 mm) soil into a 125 mL Extraction flask, add 20 mL extraction reagent, and shake on a reciprocating shaker for two hours. Filter through Whatman No.42 ashless filter paper and collect the filtrate.

Analysis: Cu, Fe, Mn, and Zn in the filtrate are determined by AAS.

Appendix B

Table 1 Major elements in serum

Serum lot no.	N (%)	NH_4^+	PO_4^{2-}(ppm)	K (ppm)	SO_4^{2-}(g/l)	Ca (ppm)	Mg (ppm)
CS 000903	0.654±0.003	5651±464	146.47±0.90	2546.50±36.30	13.79±0.21	6.03±0.60	41.65±0.65
CS 001020	0.682±0.001	5683±176	92.16±0.20	4229.50±36.30	13.82±0.19	4.49±0.30	2.57±0.01
CS 001128	0.713±0.006	5043±83	83.53±0.68	3968.80±81.40	16.11±0.33	3.17±0.14	3.56±0.06
CS 010303	0.737±0.003	5573±209	56.86±0.52	4237.20±55.00	18.70±0.23	3.63±0.05	3.29±0.14
CS 010705	0.692±0.004	5573±238	42.35±0.90	3568.40±13.20	15.44±0.13	5.01±0.06	65.90±0.00
CS 010914	0.904±0.002	2953±91	24.12±0.34	2121.90±23.10	19.20±0.45	4.00±0.20	68.65±0.55
CS 011011	0.693±0.005	2614±89	60.78±0.52	3609.10±73.70	15.36±0.10	2.75±0.21	2.32±0.06
DS 000803	0.610±0.002	5840±159	42.35±0.34	2282.50±7.70	17.03±0.37	3.00±0.21	3.81±0.11
DS 001027	0.565±0.002	5532±61	27.77±0.34	2601.50±1.10	13.99±0.09	3.06±0.11	7.54±0.01
DS 001128	0.653±0.001	2939±35	38.97±0.39	5160.00±100.0	15.90±0.16	2.75±0.31	2.80±0.28
DS 010303	0.716±0.003	6961±46	88.63±0.78	3143.80±39.60	16.66±0.18	3.42±0.39	2.69±0.09

Table 2 Minor elements in serum

Serum lot no.	Cu (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
CS 000903	0.041±0.001	1.47±0.01	0.264±0.006	166.32±4.18
CS 001020	0.038±0.002	3.18±0.07	0.071±0.003	53.27±0.56
CS 001128	0.050±0.002	1.53±0.03	0.068±0.000	186.01±0.55
CS 010303	0.103±0.059	1.65±0.01	0.070±0.000	310.00±3.00
CS 010705	0.038±0.002	1.71±0.04	0.252±0.000	214.50±3.08
CS 010914	0.043±0.005	0.81±0.00	0.296+0.002	19.75±0.19
CS 011011	0.067±0.005	1.27±0.02	0.078+0.004	129.80±2.86
DS 000803	0.071±0.011	1.66±0.03	0.049+0.001	84.12±1.64
DS 001027	0.049±0.001	1.00±0.01	0.092+0.000	78.60±0.63
DS 001128	0.057±0.003	1.13±0.03	0.110+0.002	120.31±0.25
DS 010303	0.044±0.002	1.27±0.02	0.078+0.002	157.30±1.10

Appendix C

1. Effects of CS and DS on growth of SPR 1 in hydroponic culture

1.1 Plant height (cm)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	14.0	12.9	14.8	14.0	13.9	15.2	13.6	13.0	13.6	12.5
hoagland	17.5	16.0	15.0	15.9			16.5	15.5	16.0	16.5
CS1	15.2	14.0		14.1	14.2	14.0	14.5	15.2		15.5
CS3	16.7	11.3	14.7	15.0	14.6	14.2	14.0	14.9	13.1	15.2
CS5	13.6	12.5	13.3	14.3	15.0	13.6	12.9	14.6	14.7	11.9
CS7	13.5			13.5	12.7	13.6	15.3	14.0	13.0	12.3
CS9	13.2	13.8	13.0	13.9	12.3	12.6	13.5	14.6	14.5	15.2
DS1	14.0	13.0	17.6	15.1	13.3	18.8	15.2	17.7	16.2	15.5
DS3	13.6	12.8	12.7	14.2	13.2	13.3	12.8	13.5	13.8	13.5
DS5	13.6	15.2			11.0	12.5	14.0	13.0	13.2	13.9

Analysis of variance for plant height of SPR 1 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	77.43	9	8.60	7.02**	2.63
Within Groups	100.51	82	1.23		
Total	177.94	91			

** significant at 1% level

1.2 Root length (cm)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	15.7	18.4	14.0	18.0	15.5	17.2	16.8	19.5	16.5	23.6
hoagland	19.3	10.1	8.0	8.3			10.4	12.4	15.5	8.7
CS1	9.2	9.3		5.5	7.9	11.4	12.1	13.4		8.1
CS3	5.5	10.0	10.5	11.0	5.5	10.2	6.8	6.7	5.0	8.9
CS5	4.5	6.0	4.6	8.1	6.7	10.4	7.9	7.1	4.4	3.9
CS7	8.0			6.3	11.2	10.1	4.0	10.0	3.2	2.7
CS9	9.0	5.5	5.1	10.2	7.5	11.1	5.5	6.8	9.8	7.9
DS1	8.5	8.3	9.0	5.3	6.6	6.0	4.9	10.2	8.9	6.3
DS3	7.1	5.5	8.0	10.6	7.8	11.0	11.5	4.1	11.6	11.2
DS5	4.2	5.4			4.2	10.5	5.3	5.6	6.8	12.7

Analysis of variance for root length of SPR 1 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	971.28	9	107.92	14.92**	2.63
Within Groups	592.99	82	7.23		
Total	1564.27	91			

** significant at 1% level

1.3 Leaf number

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0	3.0
hoagland	4.0	4.0	4.0	4.0			4.0	5.0	4.0	4.0
CS1	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0
CS3	5.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
CS5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
CS7	3.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0
CS9	4.0	4.0	4.0	3.0	3.0	3.0	3.0	4.0	3.0	4.0
DS1	4.0	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
DS3	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
DS5	4.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0

Analysis of variance for leaf number of SPR 1 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	12.38	9	1.36	11.48**	2.63
Within Groups	9.83	82	0.12		
Total	22.21	91			

** significant at 1% level

2. Effects of CS and DS on growth of KDML 105 in hydroponic culture

2.1 Plant height (cm)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	11.4	14.0	9.1	13.5	15.0	13.9	15.1	14.6	15.5	13.8
hoagland		15.9	19.5	21.0	19.5	18.2	18.0	20.7	18.3	18.5
CS1	17.8	17.8	15.7	17.0	17.8	16.2		19.6	15.3	15.8
CS3	18.1	17.6	18.2	16.6	14.6	18.8	14.1	19.6	15.1	18.4
CS5	17.3	17.5	16.0	15.3	15.8	16.3	15.1	15.4	15.3	14.7
CS7		13.0	15.2	14.8	13.3	10.8	14.0	15.5		
CS9	15.2		14.2	14.3	13.6	14.2	14.7	14.8		14.3
DS1	16.5	17.9	20.3	18.5	21.3	16.6	13.2	12.2	8.3	18.5
DS3		14.8	18.3	16.0	14.6	14.0	15.1	16.8	15.5	15.5
DS5	12.7		14.5		14.2	13.8	14.3	14.1	15.6	

Analysis of variance for plant height of KDML 105 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	227.39	9	25.27	6.92**	2.64
Within Groups	288.26	79	3.65		
Total	515.65	88			

** significant at 1% level

2.2 Root length (cm)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	10.5	8.1	11.3	7.5	12.0	5.8	13.6	13.2	7.0	10.3
Hoagland		8.6	8.4	9.5	8.5	7.0	8.6	7.6	12.4	11.3
CS1	7.0	7.3	6.8	9.9	7.2	5.6		7.1	8.5	5.9
CS3	5.2	8.9	9.7	10.9	8.5	8.6	7.3	5.0	3.9	6.2
CS5	6.5	5.3	6.1	6.3	6.5	4.5	11.0	6.4	5.4	7.3
CS7		6.1	4.0	6.7	7.0	4.4	6.0	8.0		
CS9	7.1		7.5	5.4	9.5	5.8	3.8	4.5		8.6
DS1	9.0	10.1	9.2	8.6	7.6	7.4	3.1	5.9	8.5	11.7
DS3		7.2	7.5	3.9	9.0	9.5	8.5	5.8	6.0	9.5
DS5	6.0		7.2		6.4	5.6	5.7	5.5	4.7	

Analysis of variance for root length of KDML 105 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	137.14	9	15.24	4.01**	2.64
Within Groups	300.33	79	3.80		
Total	437.47	88			

** significant at 1% level

2.3 Leaf number

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
Tap water	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0
Hoagland		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
CS1	4.0	4.0	4.0	4.0	4.0	3.0		4.0	3.0	3.0
CS3	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
CS5	4.0	4.0	3.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
CS7		4.0	3.0	4.0	3.0	3.0	3.0	4.0		
CS9	3.0		3.0	3.0	3.0	3.0	3.0	3.0		3.0
DS1	4.0	4.0	4.0	5.0	5.0	4.0	4.0	3.0	3.0	4.0
DS3		4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0
DS5	3.0		3.0		3.0	4.0	3.0	3.0	3.0	

Analysis of variance for leaf number of KDML 105 in hydroponic culture

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	12.98	9	1.44	7.88**	2.64
Within Groups	14.46	79	0.18		
Total	27.44	88			

** significant at 1% level

3. Effects of CS and DS application on growth and yield of SPR 1 in Pot Experiment I

3.1 Plant height (cm) at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	44.0	34.0	35.0	40.0	45.5	36.0	40.0	40.0	36.0	35.0
C2	70.0	70.0	70.0	69.3	70.0	64.5	69.5	65.0	70.0	79.0
CS1	39.0	38.0	55.0	36.5	38.0	55.5	45.0	41.0	44.0	42.0
CS3	46.0	40.5	39.0	48.0	49.0	44.0	44.0	41.0	48.0	46.0
CS5	52.0	51.0	32.0	44.5	46.5	54.0	49.5	41.5	44.0	45.0
CS7	47.5	45.0	54.0	61.5	58.0	66.0	53.0	54.0	56.5	56.0
CS9	56.0	60.5	57.0	55.5	64.5	56.0	52.0	51.0	69.0	57.0
DS1	46.8	37.0	39.0	36.5	47.5	47.0	42.0	36.0	36.5	32.5
DS3	38.0	34.0	39.0	37.0	36.0	33.0	35.0	40.5	45.0	43.0
DS5	44.0	34.0	35.0	28.0	35.0	60.0	36.5	39.0	45.0	38.0
DS7	49.5	42.5	44.0	44.0	39.5	47.0	49.5	36.0	47.5	57.0
DS9	40.0	35.0	36.5	35.5	48.0	45.0	40.0	45.0	35.0	40.0

Analysis of variance for plant height of SPR 1 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	10254.19	11	932.20	29.93**	2.42
Within Groups	3363.81	108	31.15		
Total	13618.00	119			

** significant at 1% level

3.2 Tillers/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	1	1	1	1	2	1	1	1	1	1
C2	12	13	8	13	8	15	13	6	10	20
CS1	1	1	7	1	1	3	3	2	1	1
CS3	1	1	1	2	1	3	2	2	3	3
CS5	5	4	1	3	6	6	4	3	2	2
CS7	5	3	3	9	6	9	4	6	4	6
CS9	5	8	8	8	13	4	5	4	13	11
DS1	1	1	1	1	2	1	5	1	1	1
DS3	1	1	1	1	1	1	1	1	4	1
DS5	1	1	1	1	1	6	1	1	3	1
DS7	3	2	1	2	1	2	2	3	3	6
DS9	1	2	1	1	8	1	1	1	1	1

Analysis of variance for tillers/hill of SPR 1

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	1184.69	11	107.70	24.49**	2.42
Within Groups	474.90	108	4.40		
Total	1659.59	119			

** significant at 1% level

3.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	109	117	107	106	99	123		112		104
C2	82	83	84	83	83	81	82	82	83	86
CS1		109	91	132	113	95	102	97	115	121
CS3	104	109	107	103	115	99	118	117	94	94
CS5	95	99	106	109	99	94	99	117	123	121
CS7	100	115	99	94	100	87	99	93	98	99
CS9	99	96	99	94	93	99	107	112	94	93
DS1	121	105	109		94	95				129
DS3	117		109					105	100	128
DS5	117	117	129			92		118	110	122
DS7	114	119	121	126	117	109	103	124	111	95
DS9	128	124		127	102	127	128	117	127	129

Analysis of variance for flowering day of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	10690.85	11	971.90	10.94**	2.45
Within Groups	8173.27	92	88.84		
Total	18864.12	103			

** significant at 1% level

3.4 Panicles/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	1	1	1	1	2	1	0	1	0	1
C2	9	11	11	9	13	12	11	9	10	13
CS1	0	1	6	0	1	3	2	2	1	1
CS3	2	2	1	2	1	3	1	2	3	3
CS5	5	4	4	3	6	6	4	2	1	2
CS7	13	4	4	11	8	7	10	7	8	5
CS9	6	9	11	9	25	13	6	11	13	11
DS1	1	1	1	0	2	1	0	0	0	1
DS3	1	0	1	0	0	0	0	1	4	1
DS5	1	1	1	0	0	5	0	1	2	2
DS7	3	1	1	1	1	2	2	3	3	6
DS9	1	1	0	2	9	3	1	6	2	2

Analysis of variance for panicles/hill of SPR 1

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	1663.47	11	151.22	29.52**	2.42
Within Groups	553.20	108	5.12		
Total	2216.67	119			

** significant at 1% level

3.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	1.07	0.93	0.78	1.14	2.02	1.01	1.02	1.01	0.51	0.80
C2	15.72	17.21	12.26	17.68	15.23	14.02	17.82	12.28	16.45	17.51
CS1	1.22	1.01	5.69	1.01	1.68	5.02	2.03	1.96	1.21	3.28
CS3	2.65	3.72	2.18	3.58	1.99	3.67	1.88	2.88	5.34	2.62
CS5	8.14	5.81	5.23	4.54	5.31	6.85	6.69	3.76	3.20	9.13
CS7	16.98	6.18	7.77	10.47	16.23	6.49	12.51	10.27	13.02	6.58
CS9	14.08	21.12	16.36	21.19	35.39	20.76	15.44	20.76	20.05	12.21
DS1	1.64	0.98	1.02	1.57	2.26	2.57	4.93	0.75	1.61	0.99
DS3	1.05	0.87	1.27	0.65	1.72	0.62	1.32	1.98	3.77	1.78
DS5	3.03	1.31	2.65	0.06	1.53	7.42	1.38	1.07	3.65	3.85
DS7	6.54	5.58	4.02	6.92	6.33	3.04	3.00	3.57	7.43	9.64
DS9	7.62	3.11	4.11	4.71	10.17	8.21	6.28	11.08	6.90	4.30

Analysis of variance for shoot dry weight of SPR 1

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	3971.54	11	361.05	49.39**	2.42
Within Groups	789.48	108	7.31		
Total	4761.02	119			

** significant at 1% level

3.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	0.92	4.66	0.67	0.93	1.70	0.91	0.55	0.85	0.53	0.95
C2	12.28	13.53	6.33	12.66	11.18	10.34	13.87	4.36	13.40	13.42
CS1	0.68	0.67	4.53	0.67	1.04	3.12	1.81	1.61	1.30	1.62
CS3	1.32	1.80	1.14	2.12	1.19	2.03	1.30	2.33	3.28	1.57
CS5	4.66	2.71	2.72	2.78	2.71	4.22	3.25	2.33	1.78	3.80
CS7	8.24	2.78	2.73	5.79	8.59	6.72	5.24	7.18	5.12	3.60
CS9	5.35	9.68	7.13	15.55	15.25	7.77	6.25	7.18	15.79	7.12
DS1	1.34	0.82	0.75	0.88	1.74	1.38	2.83	0.68	1.34	0.75
DS3	1.06	0.65	0.95	0.41	0.94	0.17	1.03	1.51	2.97	1.05
DS5	1.55	0.82	1.07	0.07	0.83	4.32	0.67	0.46	1.66	2.52
DS7	2.36	2.73	2.11	3.36	2.25	2.08	1.51	2.07	3.64	4.90
DS9	2.76	1.23	1.95	1.38	9.32	2.26	2.13	2.60	2.09	1.39

Analysis of variance for root dry weight of SPR 1

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	1289.42	11	117.22	30.51**	2.42
Within Groups	414.90	108	3.84		
Total	1704.32	119			

** significant at 1% level

3.7 Grain weight (g)

Treatment	r1	r2	R3	r4	r5	r6	r7	r8	r9	r10
C1	0.813	0.569	0.473	0.717	1.567	0.593	0	0.748	0	0.581
C2	15.449	7.079	16.384	18.478	20.627	15.25	16.485	14.121	17.485	17.724
CS1	0	0.868	8.631	0	1.025	5.471	2.640	2.388	0.860	1.342
CS3	1.403	2.957	1.298	2.934	0.671	2.390	0.915	1.755	5.846	3.106
CS5	8.267	5.107	4.368	2.936	5.304	7.456	5.881	1.401	0.870	2.708
CS7	15.565	4.879	5.598	13.355	14.637	11.541	12.531	10.202	10.226	5.702
CS9	9.607	20.567	10.747	14.189	36.945	22.146	8.718	15.876	20.871	11.456
DS1	0.949	1.005	0.834	0	2.455	1.754	0	0	0	0.318
DS3	0.702	0	0.892	0	0	0	0	1.415	3.585	0.507
DS5	1.523	0.737	2.057	0	0	7.425	0	0.451	1.179	2.254
DS7	4.797	1.013	1.257	0.823	0.819	0.759	2.595	2.016	4.084	2.531
DS9	1.871	0.567	0	1.996	10.352	2.365	1.179	8.479	3.002	1.500

Analysis of variance for grain weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	3894.24	11	354.02	30.88**	2.42
Within Groups	1238.22	108	11.47		
Total	5132.46	119			

** significant at 1% level

3.8 100 grain weight (g)

Treatment	r1	r2	R3	r4	r5	r6	r7	r8	r9	r10
C2	2.361	2.163	2.416	2.427	2.368	2.310	2.230	2.226	2.267	2.277
CS1			2.366			2.600	2.441			
CS3		2.486		2.460		2.284			2.658	2.336
CS5	2.581	2.446	2.428	2.112	2.106	2.568	2.492			2.450
CS7	2.198	2.307	2.084	2.366	2.361	2.290	2.213	2.271	2.265	2.325
CS9	2.237	2.427	2.018	1.998	2.273	2.286	2.176	2.143	2.305	2.103
DS7	2.213						2.470		2.194	2.133
DS9					2.302	2.222		2.254	2.148	

Analysis of variance for 100-grain weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.411	7	0.059	3.68**	3.06
Within Groups	0.735	46	0.016		
Total	1.146	53			

** significant at 1% level

3.9 Percentage of filled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	86.05	58.70	55.56	87.10	89.86	70.27		91.89		100.00
C2	84.66	44.09	87.09	83.11	88.74	71.32	71.95	89.05	70.63	78.85
CS1		97.14	76.72		76.36	89.79	89.26	92.23	81.13	69.77
CS3	57.52	83.22	86.30	86.33	55.36	76.47	89.13	65.41	89.88	78.70
CS5	87.07	74.47	76	71.82	83.95	83.09	83.51	62.75	67.24	75.84
CS7	76.81	72.32	70.34	79.10	85.70	84.19	82.35	79.58	72.68	74.55
CS9	76.46	86.76	60.67	70.91	79.87	79.06	75.85	76.55	79.72	59.84
DS1	65.08	94.74	84.21		80.51	93.33				
DS3	71.05		89.74					79.37	78.54	57.50
DS5	89.47	66.07	90.00			83.20		45.83	77.94	75.20
DS7	72.13	75.41	73.08	54.12	77.78	67.31	79.55	51.06	69.53	33.43
DS9	87.78	56.25		62.07	72.30	56.91	66.67	81.56	78.14	65.35

Analysis of variance for percentage of filled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	2500.83	11	227.35	1.62ns	1.89
Within Groups	12632.71	90	140.36		
Total	15133.54	101			

ns: not significant at 5% level

3.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	13.95	41.30	44.44	12.90	10.14	29.73		8.11		0.00
C2	15.34	55.91	12.91	16.89	11.26	28.68	28.05	10.95	29.37	21.15
CS1		2.86	23.28		23.64	10.21	10.74	7.77	18.87	30.23
CS3	42.48	16.78	13.70	13.67	44.64	23.53	10.87	34.59	10.12	21.30
CS5	12.93	25.53	23.00	28.18	16.05	16.91	16.49	37.25	32.76	24.16
CS7	23.19	27.68	29.66	20.90	14.30	15.81	17.65	20.42	27.32	25.45
CS9	23.54	13.24	39.33	29.09	20.13	20.94	24.15	23.45	20.28	40.16
DS1	34.92	5.26	15.79		19.49	6.67				
DS3	28.95		10.26					20.63	21.46	42.50
DS5	10.53	33.93	10.00			16.80		54.17	22.06	24.80
DS7	27.87	24.59	26.92	45.88	22.22	32.69	20.45	48.94	30.47	66.57
DS9	12.22	43.75		37.93	27.70	43.09	33.33	18.44	21.86	34.65

Analysis of variance for percentage of unfilled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	2502.29	11	227.48	1.62ns	1.89
Within Groups	12632.46	90	140.36		
Total	15134.75	101			

ns: not significant at 5% level

4. Effects of CS and DS application on growth and yield of KDML 105 in Pot Experiment I

4.1 Plant height (cm) at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	44.8	75.8	45.0	86.0	45.0	75.0	100.0	55.5	55.0	44.0
C2	95.0	87.0	99.0	103.0	105.0	100.5	100.0	100.0	97.0	103.5
CS1	49.0	38.0	39.0	46.0	86.0	41.0	43.0	46.5	51.2	46.0
CS3	67.0	84.5	49.0	63.0	91.8	79.0	69.0	77.0	91.0	74.0
CS5	79.5	60.0	67.0	96.0	64.0	96.0	92.5	93.0	86.0	80.0
CS7	95.5	85.0	96.0	67.5	74.0	89.0	65.3	100.5	97.0	100.0
CS9	102.5	91.2	99.0	97.0	103.0	95.0	92.0	97.0	94.0	91.0
DS1	78.5	50.0	45.5	61.0	39.5	40.0	45.0	40.5	59.0	81.0
DS3	89.5	80.0	31.0	61.0	79.0	52.0	33.0	41.5	53.0	92.0
DS5	49.0	45.0	48.5	42.5	44.0	48.0	44.0	90.5	83.5	104.0
DS7	72.5	88.5	90.0	45.0	41.0	46.0	53.5	39.0	41.5	52.0
DS9	54.5	50.0	52.5	45.5	50.5	50.0	54.5	56.0	88.0	92.0

Analysis of variance for plant height of KDML 105 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	31990	11	2908.2	11.122**	2.4163
Within Groups	28240	108	261.48		
Total	60230	119			

** significant at 1% level

4.2 Tillers/hill at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	1	2	1	2	1	2	7	1	1	1
C2	11	10	8	12	9	7	11	8	6	9
CS1	1	1	1	1	2	1	1	1	1	1
CS3	2	3	1	1	5	3	2	2	2	2
CS5	3	3	2	6	3	6	8	3	4	2
CS7	7	3	7	3	3	3	3	5	9	9
DS9	13	12	10	7	12	7	7	5	9	9
DS1	1	1	1	1	1	1	1	1	1	2
DS3	4	1	1	1	3	1	1	1	1	11
DS5	1	1	1	1	1	1	1	4	6	10
DS7	2	4	8	1	1	1	1	1	1	1
DS9	1	1	1	1	1	1	1	1	4	3

Analysis of variance for tillers/hill of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	889.50	11	80.86	18.57**	2.42
Within Groups	470.20	108	4.35		
Total	1359.70	119			

** significant at 1% level

4.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	83	65		62	81	67	53	80	77	
C2	51	48	52	51	52	51	53	51	55	53
CS1	80			90	61	90	90	82		84
CS3	71	62	81		63	67	73	70	63	71
CS5	67	74	74	60	74	62	58	67	67	68
CS7	65	69	59	77	71	67	59	62	60	61
CS9	55	60	63	60	62	63	63	63	63	62
DS1	65	81		74		85	84		71	64
DS3	59	70		71	67	90		90	79	58
DS5	82	84	90		90	90	90	59	61	53
DS7	71	63	57	90		80	79	89	86	82
DS9	79	85	81	90	81	81	82	74	67	60

Analysis of variance for flowering day of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	7424.46	11	674.95	8.36**	2.44
Within Groups	7666.19	95	80.70		
Total	15090.65	106			

** significant at 1% level

4.4 Panicles/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	1	0	0	2	1	2	5	1	1	0
C2	9	10	8	12	9	8	11	7	6	9
CS1	1	0	0	1	2	1	1	1	0	1
CS3	2	3	1	0	5	2	2	2	2	2
CS5	4	3	1	6	2	6	8	3	5	3
CS7	8	6	7	9	3	3	4	6	9	8
CS9	11	12	14	8	12	11	7	9	15	13
DS1	1	1	0	1	0	0	1	0	0	2
DS3	4	0	0	1	3	1	0	1	1	8
DS5	1	1	1	0	1	1	1	4	6	8
DS7	2	4	8	0	0	1	1	1	0	1
DS9	1	0	1	1	1	1	1	1	4	3

Analysis of variance for panicles/hill of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1301.67	11	118.33	31.19**	2.42
Within Groups	409.80	108	3.79		
Total	1711.47	119			

** significant at 1% level

4.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	0.47	2.03	0.87	2.48	1.60	1.20	6.82	0.98	0.72	0.53
C2	10.00	9.15	9.13	13.52	11.26	10.42	11.19	11.52	7.90	12.14
CS1	0.68	0.23	0.31	0.47	2.42	0.30	0.31	0.66	0.82	0.34
CS3	1.86	3.02	1.13	0.60	5.64	2.22	5.20	3.22	3.00	2.11
CS5	6.74	4.40	4.53	6.17	2.82	7.17	7.83	7.54	8.85	5.96
CS7	13.00	7.45	8.57	12.01	4.15	4.63	5.29	11.39	14.81	9.57
CS9	22.96	15.99	17.91	15.03	19.54	17.86	11.27	15.54	16.34	17.47
DS1	2.03	0.89	0.30	0.78	0.24	0.31	0.38	0.24	1.57	1.85
DS3	5.43	1.81	0.15	0.83	3.51	1.08	0.09	0.74	4.88	16.84
DS5	1.08	0.56	0.99	0.52	0.66	0.59	0.80	4.86	7.11	10.32
DS7	1.61	3.79	7.59	0.69	1.10	0.84	1.68	0.87	0.37	0.75
DS9	0.88	1.45	0.88	0.55	1.07	1.88	1.48	1.01	4.68	3.56

Analysis of variance for shoot dry weight of KDML 105

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	2720.06	11	247.28	36.81**	2.42
Within Groups	725.57	108	6.72		
Total	3445.63	119			

** significant at 1% level

4.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	0.58	2.28	0.28	1.87	0.73	0.70	3.36	0.56	0.51	0.20
C2	4.39	4.61	2.59	5.35	4.99	4.87	4.24	6.11	3.54	4.95
CS1	0.40	0.09	0.17	0.39	2.13	0.21	0.20	0.52	0.61	0.23
CS3	0.96	1.76	0.54	0.28	3.06	1.65	2.24	1.80	1.65	0.96
CS5	2.18	1.38	1.06	2.80	1.23	3.66	4.37	2.22	2.59	2.06
CS7	4.02	2.51	3.31	3.52	1.68	2.42	1.85	5.11	5.12	4.13
CS9	5.82	4.18	4.96	3.87	7.75	4.49	3.05	4.24	5.35	4.28
DS1	1.14	0.42	0.11	0.71	0.13	0.20	0.27	0.16	0.63	1.32
DS3	3.37	0.68	0.09	0.48	1.19	0.50	0.50	0.38	1.73	10.26
DS5	0.61	0.27	0.57	0.20	0.33	0.34	0.42	3.04	2.62	5.29
DS7	0.84	1.56	2.93	0.33	0.52	0.57	1.23	0.39	0.25	0.35
DS9	0.39	0.52	0.49	0.29	0.77	0.60	0.50	0.59	1.79	1.80

Analysis of variance for root dry weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	250.63	11	22.78	12.98**	2.42
Within Groups	189.55	108	1.76		
Total	440.18	119			

** significant at 1% level

4.7 Grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	0.231	0	0	2.425	0.400	1.087	8.506	0.114	0.415	0
C2	9.437	12.811	14.523	15.806	12.750	12.625	15.697	10.746	9.987	15.942
CS1	0.420	0	0	0.277	1.623	0.023	0.120	0.348	0	0.210
CS3	1.025	0.794	1.011	0	5.539	1.125	1.558	1.921	2.462	2.024
CS5	3.897	1.816	0.684	3.959	1.030	7.254	8.225	3.898	4.632	1.709
CS7	5.132	4.922	6.006	4.721	2.084	0.832	1.794	4.483	8.066	8.142
CS9	11.040	8.834	13.067	5.163	13.310	6.984	6.550	5.580	13.250	15.108
DS1	1.254	0.280	0	0.085	0	0	0.138	0	0	1.438
DS3	3.626	0	0	0.480	3.609	0.380	0	0.26	0.682	3.651
DS5	0.403	0.208	0.380	0	0.291	0.262	0.305	3.605	5.634	11.001
DS7	0.958	2.953	6.642	0	0	0.230	0.393	0.200	0	0.350
DS9	0.593	0	0.569	0.206	0.369	0.247	0.228	0.472	3.305	2.418

Analysis of variance for grain weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1800.84	11	163.71	30.99**	2.42
Within Groups	570.59	108	5.28		
Total	2371.43	119			

** significant at 1% level

4.8 100 grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C2	2.329	2.390	2.389	2.302	2.435	2.451	2.382	2.398	2.623	2.504
CS5	2.450			2.326		2.394	2.328		2.284	
CS7	2.426	2.411	2.283	2.304				2.520	2.315	2.327
CS9	2.264	2.418	2.348	2.275	2.313	2.350	2.331	2.555	2.284	2.363
DS3	2.460				2.524					1.633
DS5								2.540	2.411	2.322

Analysis of variance for 100-grain weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.120	5	0.024	1.06ns	2.51
Within Groups	0.721	32	0.023		
Total	0.841	37			

ns: not significant at 5% level

4.9 Percentage of filled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	90.91			87.39	94.12	92.00	83.37	55.56	85.00	
C2	65.01	78.00	79.82	68.12	79.69	76.60	75.75	75.93	82.30	81.70
CS1	94.44			84.62	97.01	70.00	66.67	68.42		76.92
CS3	86.27	72.34	83.67		85.02	80.65	58.18	74.76	79.39	81.37
CS5	69.87	71.82	84.38	72.84	62.69	81.88	84.86	60.00	77.57	73.79
CS7	58.11	66.99	75.43	70.00	72.13	66.67	47.50	84.69	70.80	74.32
CS9	55.88	53.91	56.94	42.57	70.50	41.04	71.07	43.23	59.44	63.08
DS1	92.73	63.16		44.44			60.00			76.54
DS3	88.10			91.30	85.21	76.19		71.43	93.10	
DS5	84.21	72.73	100.00		66.67	84.62	73.68	88.68	86.45	86.45
DS7	74.51	82.43	83.48			76.92	85.71	50.00		88.24
DS9	82.14		77.42	69.23		52.17	40.00	80.00	76.32	82.20

Analysis of variance for percentage of filled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	6454.03	11	586.73	4.70**	2.46
Within Groups	10729.29	86	124.76		
Total	17183.32	97			

** significant at 1% level

4.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
C1	9.09			12.61	5.88	8.00	16.63	44.44	15.00	
C2	34.99	22.00	20.18	31.88	20.31	23.40	24.25	24.07	17.70	18.30
CS1	5.56			15.38	2.99	30.00	33.33	31.58		23.08
CS3	13.73	27.66	16.33		14.98	19.35	41.82	25.24	20.61	18.63
CS5	30.13	28.18	15.63	27.16	37.31	18.12	15.14	40.00	22.43	26.21
CS7	41.89	33.01	24.57	30.00	27.87	33.33	52.50	15.31	29.20	25.68
CS9	44.12	46.09	43.06	57.43	29.50	58.96	28.93	56.77	40.56	36.92
DS1	7.27	36.84		55.56			40.00			23.46
DS3	11.90			8.70	14.79	23.81		28.57	6.90	
DS5	15.79	27.27	0		33.33	15.38	26.32	11.32	13.55	13.55
DS7	25.49	17.57	16.52			23.08	14.29	50.00		11.76
DS9	17.86		22.58	30.77		47.83	60.00	20.00	23.68	17.80

Analysis of variance for percentage of unfilled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	6454.03	11	586.73	4.70**	2.46
Within Groups	10729.29	86	124.76		
Total	17183.32	97			

** significant at 1% level

5. Effects of CS in combination with ammonium phosphate fertilizer on growth and yield of SPR 1 in Pot Experiment II

5.1 Plant height (cm) at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	68.00	69.00	72.50	62.00	68.00	67.00	59.00	66.00	72.00	63.00
T2	95.00	85.00	91.00	94.50	91.00	92.00	92.00	92.00	88.00	92.00
T3	73.00	59.50	64.00	70.00	64.00	74.00	76.50	74.50	64.00	74.50
T4	79.00	75.00	83.00	84.00	79.00	79.00	82.00	80.00	74.50	77.00
T5	90.00	87.00	81.00	86.00	87.00	88.00	80.00	77.00	85.30	84.00
T6	87.50	96.00	92.00	92.00	89.00	92.00	92.00	97.00	100.50	89.50

Analysis of variance for plant height of SPR 1 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	5983.46	5	1196.69	68.33**	3.38
Within Groups	945.68	54	17.51		
Total	6929.14	59			

** significant at 1% level

5.2 Tillers/hill at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3	3	2	2	3	3	2	3	2	3
T2	11	10	12	11	15	14	11	13	11	12
T3	9	5	4	11	4	8	9	6	11	6
T4	8	6	14	14	11	14	13	13	5	14
T5	23	17	12	22	24	19	19	17	14	20
T6	23	16	16	18	17	18	17	15	20	22

Analysis of variance for tillers/hill of SPR 1 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1937.53	5	387.51	52.60**	3.38
Within Groups	397.80	54	7.37		
Total	2335.33	59			

** significant at 1% level

5.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	90	93	105	103	97	97	96	89	96	103
T2	90	87	89	88	88	91	88	89	88	89
T3	106	130	123	123	131	123	103	123	123	111
T4	97	98	93	97	102	97	93	92	111	97
T5	95	88	93	94	94	93	90	98	93	94
T6	88	88	88	93	88	86	84	88	88	84

Analysis of variance for flowering day of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	6844.13	5	1368.83	49.03**	3.38
Within Groups	1507.60	54	27.92		
Total	8351.73	59			

** significant at 1% level

5.4 Panicles/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3	3	2	2	3	2	2	3	2	3
T2	8	7	8	9	10	9	9	9	9	12
T3	7	5	7	9	4	5	8	8	9	6
T4	8	8	11	12	11	12	12	13	5	13
T5	19	17	12	19	13	17	20	16	14	17
T6	14	14	15	12	14	19	17	13	14	18

Analysis of variance for panicles/hill of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1336.93	5	267.39	65.93**	3.38
Within Groups	219.00	54	4.06		
Total	1555.93	59			

** significant at 1% level

5.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3.78	3.59	3.53	2.61	4.81	3.18	2.72	5.16	4.70	4.24
T2	17.45	16.11	18.19	17.76	20.11	18.50	17.91	18.04	18.19	19.42
T3	23.33	19.29	19.59	27.21	15.49	25.96	21.33	37.79	32.82	23.02
T4	21.53	21.32	27.95	33.82	30.73	26.56	31.31	32.03	20.84	34.07
T5	45.88	36.47	29.24	42.44	37.87	41.60	43.49	31.57	37.91	40.60
T6	33.54	28.80	34.15	32.08	30.34	36.00	39.92	30.05	31.91	34.10

Analysis of variance for shoot dry weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	7551.78	5	1510.36	81.07**	3.38
Within Groups	1006.08	54	18.63		
Total	8557.86	59			

** significant at 1% level

5.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	R9	r10
T1	1.58	1.73	1.45	1.44	2.19	1.56	1.85	2.44	2.00	2.34
T2	5.89	6.49	7.86	6.67	7.10	4.80	6.56	6.64	7.46	6.06
T3	8.97	6.50	6.34	8.18	4.27	7.95	5.83	8.00	11.40	5.96
T4	6.81	6.71	10.03	10.84	7.14	6.96	9.19	8.51	7.84	8.97
T5	14.24	10.36	11.28	12.49	12.50	15.46	13.51	7.14	12.85	12.20
T6	13.67	10.91	11.22	10.28	11.26	12.66	14.07	9.12	10.66	11.71

Analysis of variance for root dry weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	706.48	5	141.30	58.49**	3.38
Within Groups	130.59	54	2.42		
Total	837.07	59			

** significant at 1% level

5.7 Grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	2.261	2.711	2.329	2.067	2.663	2.242	2.438	5.090	3.608	2.381
T2	13.642	12.879	14.844	16.097	14.901	13.920	14.134	14.074	14.892	13.028
T3	12.231	5.693	9.867	12.146	5.154	14.891	13.791	19.499	11.232	3.802
T4	16.183	16.263	23.147	22.706	29.042	19.179	23.088	28.230	9.180	16.514
T5	33.600	33.286	24.132	32.899	26.706	36.685	34.482	28.183	27.882	31.199
T6	32.705	27.883	28.052	27.114	29.407	31.700	39.307	28.471	31.198	37.002

Analysis of variance for grain weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	6448.03	5	1289.61	81.38**	3.38
Within Groups	856.06	54	15.85		
Total	7304.09	59			

** significant at 1% level

5.8 100 grain weight (g)

Treatment	r1	r2	R3	r4	r5	r6	r7	r8	r9	r10
T1		2.551			2.618		2.350	2.462	2.405	
T2	2.373	2.352	2.373	2.401	2.303	2.421	2.310	2.323	2.391	2.357
T3	2.547	2.402	2.464	2.318	2.137	2.335	2.729	2.405	2.169	2.481
T4	2.530	2.489	2.550	2.455	2.597	2.463	2.475	2.472	2.687	2.426
T5	2.580	2.671	2.789	2.413	2.429	2.540	2.470	2.632	2.427	2.767
T6	2.466	2.434	2.460	2.593	2.446	2.414	2.426	2.388	2.492	2.638

Analysis of variance for 100 grains weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.294	5	0.059	4.61**	3.42
Within Groups	0.625	49	0.013		
Total	0.919	54			

** significant at 1% level

5.9 Percentage of filled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	52.98	56.38	74.40	82.86	67.76	73.02	86.07	84.71	75.88	65.75
T2	73.82	76.63	71.20	68.90	66.87	69.52	70.64	70.54	64.74	58.96
T3	77.50	48.02	80.61	80.37	63.19	86.19	77.93	89.17	71.11	26.71
T4	78.23	83.94	87.48	72.23	84.16	76.76	84.78	82.52	77.18	62.24
T5	70.35	76.12	78.82	71.77	71.67	80.97	81.23	76.27	70.24	70.71
T6	83.56	76.22	70.27	79.20	72.48	69.59	77.36	80.94	75.42	80.80

Analysis of variance for percentage of filled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	735.65	5	147.13	1.41ns	2.39
Within Groups	5630.12	54	104.26		
Total	6365.77	59			

ns: not significant at 5% level

5.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	47.02	43.62	25.60	17.14	32.24	26.98	13.93	15.29	24.12	34.25
T2	26.18	23.37	28.80	31.10	33.13	30.48	29.36	29.46	35.26	41.04
T3	22.50	51.98	19.39	19.63	36.81	13.81	22.07	10.83	28.89	73.29
T4	21.77	16.06	12.52	27.77	15.84	23.24	15.22	17.48	22.82	37.76
T5	29.65	23.88	21.18	28.23	28.33	19.03	18.77	23.73	29.76	29.29
T6	16.44	23.78	29.73	20.80	27.52	30.41	22.64	19.06	24.58	19.20

Analysis of variance for percentage of unfilled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	735.65	5	147.13	1.41ns	2.39
Within Groups	5630.12	54	104.26		
Total	6365.77	59			

ns: not significant at 5% level

6. Effects of CS in combination with ammonium phosphate fertilizer on growth and yield of KDML 105 in Pot Experiment II

6.1 Plant height (cm) at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	73	78.2	96	84	78	67	83	87	88	75
T2	103	112	111	103	103	107	100	103	103.5	106
T3	80	98	91	92.5	95	89.5	99	70	93	86
T4	110	99	92.5	110	106	93	92	98.5	102	99.5
T5	117.5	110	121.5	107.5	114.3	121.5	111	110	117	110
T6	117	106.5	117.5	124.5	117.5	117	123	111	115.5	104.5

Analysis of variance for plant height of KDML 105 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	9325.72	5	1865.14	40.53**	3.38
Within Groups	2484.81	54	46.01		
Total	11810.53	59			

** significant at 1% level

6.2 Tillers/hill at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	4	3	3	3	3	1	2	2	2	1
T2	9	9	8	6	8	7	12	9	9	9
T3	6	8	6	7	7	4	5	7	6	4
T4	16	11	12	14	14	12	11	11	8	12
T5	16	14	20	14	20	15	15	21	20	16
T6	16	18	21	17	12	16	15	20	14	21

Analysis of variance for tillers/hill of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1778.33	5	355.67	79.17**	3.38
Within Groups	242.60	54	4.49		
Total	2020.93	59			

** significant at 1% level

6.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	91	88	84	85	90	92	91	88	93	91
T2	89	89	85	83	88	89	86	86	85	87
T3	92	85	89	91	89	89	89	89	89	89
T4	85	86	88	83	85	88	87	85	88	86
T5	81	83	84	86	86	85	83	82	85	85
T6	83	84	85	84	84	84	85	86	86	82

Analysis of variance for flowering day of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	258.48	5	51.70	13.16**	3.38
Within Groups	212.10	54	3.93		
Total	470.58	59			

** significant at 1% level

6.4 Panicles/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	2	2	2	3	2	1	1	1	2	1
T2	6	6	7	6	6	7	10	6	6	5
T3	5	6	4	4	7	4	4	5	4	3
T4	14	11	8	11	12	8	10	6	7	9
T5	16	12	14	11	15	12	15	15	15	14
T6	12	11	13	11	10	12	9	13	11	15

Analysis of variance for panicles/hill of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1045.60	5	209.12	81.59**	3.38
Within Groups	138.40	54	2.56		
Total	1184.00	59			

** significant at 1% level

6.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3.46	3.36	4.46	7.05	3.61	1.81	2.42	3.08	3.94	1.75
T2	16.56	17.08	16.58	14.18	19.84	17.22	18.55	15.40	19.70	15.36
T3	11.02	20.19	13.49	15.20	15.79	13.00	10.76	12.31	18.71	9.76
T4	40.28	27.15	29.40	37.02	31.35	26.11	24.99	24.21	20.90	30.62
T5	48.50	39.31	34.86	35.41	42.09	39.21	43.28	41.58	45.88	40.51
T6	33.23	40.42	36.87	36.58	30.56	33.22	33.59	39.83	37.34	32.15

Analysis of variance for shoot dry weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	10136.84	5	2027.37	148.81**	3.38
Within Groups	735.71	54	13.62		
Total	10872.55	59			

** significant at 1% level

6.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	1.66	1.66	2.11	2.89	1.74	0.84	1.34	1.44	1.99	1.11
T2	7.36	9.00	9.98	5.60	9.64	7.10	8.64	7.07	8.26	6.92
T3	4.45	7.23	5.54	5.37	5.28	3.87	3.44	5.65	6.85	2.86
T4	23.86	13.18	13.82	18.95	17.16	15.31	9.49	8.69	7.95	13.44
T5	25.69	17.70	16.94	17.65	22.13	17.79	25.71	22.84	26.86	23.41
T6	13.17	17.31	15.23	20.37	11.09	13.21	15.69	14.63	16.84	14.61

Analysis of variance for root dry weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	2733.07	5	546.61	65.55**	3.38
Within Groups	450.29	54	8.34		
Total	3183.35	59			

** significant at 1% level

6.7 Grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	1.900	2.148	4.570	5.951	2.154	1.574	1.464	1.663	4.332	1.112
T2	14.204	12.982	12.774	9.790	11.374	13.064	15.633	11.918	12.773	11.878
T3	4.229	8.280	5.853	6.275	10.804	6.960	5.237	5.644	10.879	5.086
T4	33.408	16.778	16.298	8.303	12.320	11.785	14.456	14.126	11.028	13.688
T5	28.336	18.194	29.334	20.318	25.350	20.525	38.752	32.262	39.300	27.430
T6	31.249	28.838	30.103	29.212	23.549	23.098	22.820	30.594	26.779	32.827

Analysis of variance for grain weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	5556.41	5	1111.28	53.52**	3.38
Within Groups	1121.30	54	20.76		
Total	6677.71	59			

** significant at 1% level

6.8 100 grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1			2.453	2.480					2.525	
T2	2.405	2.504	2.272	2.195	2.296	2.180	2.447	2.288	2.317	2.495
T3	2.335	2.608	2.502	2.512	2.446	2.538	2.438	2.374	2.643	2.609
T4	2.557	2.343	2.337	2.290	2.327	2.489	2.420	2.689	2.423	2.403
T5	2.253	2.419	2.513	2.316	2.391	2.253	2.425	2.395	2.458	2.449
T6	2.572	2.391	2.553	2.487	2.348	2.352	2.386	2.552	2.504	2.246

Analysis of variance for 100 grains weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.157	5	0.031	2.77*	2.41
Within Groups	0.531	47	0.011		
Total	0.688	52			

*significant at 5% level

6.9 Percentage of filled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	55.69	57.52	72.87	76.58	61.90	89.55	57.58	53.17	88.54	65.75
T2	71.24	77.84	68.83	62.45	64.17	75.29	69.35	66.32	72.33	65.73
T3	80.53	66.11	73.54	89.40	85.04	76.86	82.31	85.36	85.51	88.24
T4	84.82	71.71	79.41	40.29	46.34	67.04	79.40	82.60	79.30	60.54
T5	66.18	63.57	70.38	64.81	67.71	62.90	85.31	72.14	77.18	72.98
T6	75.14	71.17	72.19	76.84	74.58	63.12	81.48	75.87	72.88	80.05

Analysis of variance for percentage of filled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1263.57	5	252.71	2.65*	2.39
Within Groups	5157.71	54	95.51		
Total	6421.28	59			

*significant at 5% level

6.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	44.31	42.48	27.13	23.42	38.10	10.45	42.42	46.83	11.46	34.25
T2	28.76	22.16	31.17	37.55	35.83	24.71	30.65	33.68	27.67	34.27
T3	19.47	33.89	26.46	10.60	14.96	23.14	17.69	14.64	14.49	11.76
T4	15.18	28.29	20.59	59.71	53.66	32.96	20.60	17.40	20.70	39.46
T5	33.82	36.43	29.62	35.19	32.29	37.10	14.69	27.86	22.82	27.02
T6	24.86	28.83	27.81	23.16	25.42	36.88	18.52	24.13	27.12	19.95

Analysis of variance for percentage of unfilled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1263.57	5	252.71	2.65*	2.39
Within Groups	5157.71	54	95.51		
Total	6421.28	59			

* significant at 5% level

7. Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on growth and yield of SPR 1 in Pot Experiment III

7.1 Plant height (cm) at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	68.00	69.00	72.50	62.00	68.00	67.00	59.00	66.00	72.00	63.00
T2	95.00	85.00	91.00	94.50	91.00	92.00	92.00	92.00	88.00	92.00
T3	73.00	59.50	64.00	70.00	64.00	74.00	76.50	74.50	64.00	74.50
T7	68.00	73.00	82.00	66.50	75.00	76.00	73.00	77.00	77.50	81.50
T8	76.00	72.00	81.00	86.00	76.50	77.00	76.00	75.50	80.00	79.00
T9	80.00	76.00	76.50	85.00	90.50	83.50	96.00	83.00	86.50	90.00

Analysis of variance for plant height of SPR 1 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	4308.94	5	861.79	36.07**	3.38
Within Groups	1290.27	54	23.89		
Total	5599.21	59			

** significant at 1% level

7.2 Tillers/hill at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3	3	2	2	3	3	2	3	2	3
T2	11	10	12	11	15	14	11	13	11	12
T3	9	5	4	11	4	8	9	6	11	6
T7	11	13	13	7	14	12	11	9	14	13
T8	15	10	14	18	11	14	9	11	14	14
T9	21	22	20	23	23	20	20	23	19	16

Analysis of variance for tillers/hill of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1835.48	5	367.09	81.01**	3.38
Within Groups	244.70	54	4.53		
Total	2080.18	59			

** significant at 1% level

7.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	90	93	105	103	97	97	96	89	96	103
T2	90	87	89	88	88	91	88	89	88	89
T3	106	130	123	123	131	123	103	123	123	111
T7	113	106	97	119	106	112	113	105	105	102
T8	99	104	97	101	104	104	96	104	99	104
T9	94	99	96	101	93	94	88	93	92	101

Analysis of variance for flowering day of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	5933.35	5	1186.67	37.05**	3.38
Within Groups	1729.50	54	32.03		
Total	7662.85	59			

** significant at 1% level

7.4 Panicles/hill

Treatment	r1	r2	r3	r4	R5	r6	r7	r8	r9	r10
T1	3	3	2	2	3	2	2	3	2	3
T2	8	7	8	9	10	9	9	9	9	12
T3	7	5	7	9	4	5	8	8	9	6
T7	10	12	13	9	8	12	11	9	12	13
T8	16	10	13	20	11	14	11	11	15	15
T9	18	22	19	22	22	20	19	16	16	20

Analysis of variance for panicles/hill of SPR1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1688.13	5	337.63	88.59**	3.38
Within Groups	205.80	54	3.81		
Total	1893.93	59			

** significant at 1% level

7.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3.78	3.59	3.53	2.61	4.81	3.18	2.72	5.16	4.70	4.24
T2	17.45	16.11	18.19	17.76	20.11	18.50	17.91	18.04	18.19	19.42
T3	23.33	19.29	19.59	27.21	15.49	25.96	21.33	37.79	32.82	23.02
T7	27.08	36.54	30.80	25.04	28.12	36.83	32.77	29.51	43.63	46.83
T8	44.80	33.82	38.81	54.76	41.30	45.31	32.84	30.18	45.23	40.45
T9	49.07	62.14	57.62	65.78	63.12	54.86	54.64	57.35	51.87	66.96

Analysis of variance for shoot dry weight of SPR 1

Source of Variation	*SS*	*Df*	*MS*	*F*	*F crit*
Between Groups	17866.18	5	3573.24	114.42**	3.38
Within Groups	1686.40	54	31.23		
Total	19552.58	59			

** significant at 1% level

7.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	1.58	1.73	1.45	1.44	2.19	1.56	1.85	2.44	2.00	2.34
T2	5.89	6.49	7.86	6.67	7.10	4.80	6.56	6.64	7.46	6.06
T3	8.97	6.50	6.34	8.18	4.27	7.95	5.83	8.00	11.40	5.96
T7	8.62	7.98	8.11	10.23	7.48	11.31	10.63	7.89	7.16	12.48
T8	10.68	8.02	10.96	20.93	9.64	17.49	8.00	8.70	12.41	11.46
T9	19.39	23.80	26.96	22.32	22.19	15.95	13.60	27.16	11.77	19.14

Analysis of variance for root dry weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1923.62	5	384.72	42.82**	3.38
Within Groups	485.16	54	8.98		
Total	2408.78	59			

** significant at 1% level

7.7 Grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	2.261	2.711	2.329	2.067	2.663	2.242	2.438	5.090	3.608	2.381
T2	13.642	12.879	14.844	16.097	14.901	13.920	14.134	14.074	14.892	13.028
T3	12.231	5.693	9.867	12.146	5.154	14.891	13.791	19.499	11.232	3.802
T7	13.777	13.766	19.334	13.005	12.905	21.285	12.530	13.051	20.843	32.703
T8	22.491	14.586	24.562	39.673	16.231	18.263	22.511	17.911	30.887	25.608
T9	36.290	42.072	35.685	45.139	48.239	35.362	44.760	33.470	37.518	45.440

Analysis of variance for grain weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	8269.98	5	1653.99	65.26**	3.38
Within Groups	1368.66	54	25.35		
Total	9638.64	59			

** significant at 1% level

7.8 100 grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1		2.551			2.618		2.350	2.462	2.405	
T2	2.373	2.352	2.373	2.401	2.303	2.421	2.310	2.323	2.391	2.357
T3	2.547	2.402	2.464	2.318	2.137	2.335	2.729	2.405	2.169	2.481
T7	2.374	2.385	2.580	2.353	2.460	2.582	2.596	2.378	2.717	2.462
T8	2.405	2.506	2.669	2.495	2.736	2.230	2.666	2.530	2.530	2.443
T9	2.489	2.436	2.484	2.496	2.647	2.441	2.520	2.442	2.365	2.480

Analysis of variance for 100 grain weight of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.184	5	0.037	2.53*	2.40
Within Groups	0.714	49	0.015		
Total	0.898	54			

* significant at 5% level

7.9 Percentage of filled grain

Treatment	r1	r2	R3	r4	r5	r6	r7	r8	r9	r10
T1	52.98	56.38	74.40	82.86	67.76	73.02	86.07	84.71	75.88	65.75
T2	73.82	76.63	71.20	68.90	66.87	69.52	70.64	70.54	64.74	58.96
T3	77.50	48.02	80.61	80.37	63.19	86.19	77.93	89.17	71.11	26.71
T7	71.15	55.38	78.17	76.13	67.01	82.88	68.02	61.89	67.72	80.70
T8	73.13	70.39	78.38	86.07	67.73	66.58	80.19	76.29	85.45	81.88
T9	78.21	80.80	75.80	78.91	79.76	67.44	81.90	75.83	79.93	81.44

Analysis of variance for percentage of filled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	663.08	5	132.62	1.19ns	2.39
Within Groups	6030.54	54	111.68		
Total	6693.62	59			

ns: not significant at 5% level

7.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	47.02	43.62	25.60	17.14	32.24	26.98	13.93	15.29	24.12	34.25
T2	26.18	23.37	28.80	31.10	33.13	30.48	29.36	29.46	35.26	41.04
T3	22.50	51.98	19.39	19.63	36.81	13.81	22.07	10.83	28.89	73.29
T4	28.85	44.62	21.83	23.87	32.99	17.12	31.98	38.11	32.28	19.30
T5	26.87	29.61	21.62	13.93	32.27	33.42	19.81	23.71	14.55	18.12
T6	21.79	19.20	24.20	21.09	20.24	32.56	18.10	24.17	20.07	18.56

Analysis of variance for percentage of unfilled grain of SPR 1

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	663.08	5	132.62	1.19ns	2.39
Within Groups	6030.54	54	111.68		
Total	6693.62	59			

ns: not significant at 5% level

8. Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on growth and yield of KDML 105 in Pot Experiment III

8.1 Plant height (cm) of KDML 105 at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	73	78.2	96	84	78	67	83	87	88	75
T2	103	112	111	103	103	107	100	103	103.5	106
T3	80	98	91	92.5	95	89.5	99	70	93	86
T7	97	102.5	96.5	98	94.5	105	92	95	92	93.5
T8	96	102.5	100.5	96	97.5	95.3	100	113	92.3	96.3
T9	111	110	111	117	110	105	99	119	119	119

Analysis of variance for plant height of KDML 105 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	6115.03	5	1223.01	28.32**	3.38
Within Groups	2331.69	54	43.18		
Total	8446.72	59			

** significant at 1% level

8.2 Tillers/hill at day 70

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	4	3	3	3	3	1	2	2	2	1
T2	9	9	8	6	8	7	12	9	9	9
T3	6	8	6	7	7	4	5	7	6	4
T7	6	9	9	8	7	13	8	11	13	8
T8	12	13	14	13	7	13	13	12	13	13
T9	17	16	26	17	19	16	15	24	14	23

Analysis of variance for tillers/hill of KDML 105 at day 70

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1560.33	5	312.07	58.39**	3.38
Within Groups	288.60	54	5.34		
Total	1848.93	59			

** significant at 1% level

8.3 Flowering day

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	91	88	84	85	90	92	91	88	93	91
T2	89	89	85	83	88	89	86	86	85	87
T3	92	85	89	91	89	89	89	89	89	89
T7	89	85	88	85	88	88	89	88	88	91
T8	85	88	86	88	86	87	84	82	86	87
T9	84	84	84	84	86	85	85	86	82	83

Analysis of variance for flowering day of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	188.60	5	37.72	9.22**	3.38
Within Groups	221.00	54	4.09		
Total	409.60	59			

** significant at 1% level

8.4 Panicles/hill

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	2	2	2	3	2	1	1	1	2	1
T2	6	6	7	6	6	7	10	6	6	5
T3	5	6	4	4	7	4	4	5	4	3
T7	6	8	8	8	6	10	7	8	11	7
T8	12	12	14	13	12	13	10	12	12	13
T9	12	16	16	18	20	16	12	20	17	19

Analysis of variance for panicles/hill of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1455.33	5	291.07	111.95**	3.38
Within Groups	140.40	54	2.60		
Total	1595.73	59			

** significant at 1% level

8.5 Shoot dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	3.46	3.36	4.46	7.05	3.61	1.81	2.42	3.08	3.94	1.75
T2	16.56	17.08	16.58	14.18	19.84	17.22	18.55	15.40	19.70	15.36
T3	11.02	20.19	13.49	15.20	15.79	13.00	10.76	12.31	18.71	9.76
T7	19.49	25.44	26.91	22.61	18.73	29.92	22.53	25.82	29.21	22.97
T8	38.97	44.45	41.40	33.02	36.05	36.81	29.64	33.01	39.74	44.05
T9	56.14	48.47	50.23	52.18	60.92	52.23	38.59	65.20	53.61	59.13

Analysis of variance for shoot dry weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	16302.57	5	3260.51	176.65**	3.38
Within Groups	996.70	54	18.46		
Total	17299.27	59			

** significant at 1% level

8.6 Root dry weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	1.66	1.66	2.11	2.89	1.74	0.84	1.34	1.44	1.99	1.11
T2	7.36	9.00	9.98	5.60	9.64	7.10	8.64	7.07	8.26	6.92
T3	4.45	7.23	5.54	5.37	5.28	3.87	3.44	5.65	6.85	2.86
T7	7.51	7.88	9.58	8.42	4.57	6.85	6.70	8.35	12.42	6.76
T8	15.33	15.66	15.94	12.52	11.00	11.86	9.54	7.95	14.30	11.58
T9	15.42	15.84	17.00	16.70	15.71	24.57	11.23	22.47	13.34	18.62

Analysis of variance for root dry weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	1491.41	5	298.28	56.56**	3.38
Within Groups	284.776	54	5.27		
Total	1776.18	59			

** significant at 1% level

8.7 Grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	1.900	2.148	4.570	5.951	2.154	1.574	1.464	1.663	4.332	1.112
T2	14.204	12.982	12.774	9.790	11.374	13.064	15.633	11.918	12.773	11.878
T3	4.229	8.280	5.853	6.275	10.804	6.960	5.237	5.644	10.879	5.086
T7	6.920	14.225	10.657	14.383	10.872	15.380	10.458	8.906	15.750	9.379
T8	17.820	14.002	30.310	23.788	19.523	19.877	14.174	17.268	15.233	27.112
T9	9.501	19.557	21.984	22.683	29.262	29.795	14.571	38.240	23.002	24.281

Analysis of variance for grain weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	2985.80	5	597.16	31.01**	3.38
Within Groups	1039.99	54	19.26		
Total	4025.79	59			

** significant at 1% level

8.8 100 grain weight (g)

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1			2.453	2.480					2.525	
T2	2.405	2.504	2.272	2.195	2.296	2.180	2.447	2.288	2.317	2.495
T3	2.335	2.608	2.502	2.512	2.446	2.538	2.438	2.374	2.643	2.609
T7	2.322	2.584	2.494	2.440	2.521	2.557	2.495	2.340	2.419	2.390
T8	2.557	2.323	2.486	2.469	2.416	2.358	2.418	2.358	2.320	2.453
T9	2.280	2.266	2.311	2.303	2.496	2.312	2.394	2.264	2.196	2.221

Analysis of variance for 100 grain weight of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	0.282	5	0.056	6.41**	3.43
Within Groups	0.413	47	0.009		
Total	0.695	52			

** significant at 1% level

8.9 Percentage of filled grain

Treatment	r1	r2	R3	r4	r5	r6	r7	r8	r9	r10
T1	55.69	57.52	72.87	76.58	61.90	89.55	57.58	53.17	88.54	65.75
T2	71.24	77.84	68.83	62.45	64.17	75.29	69.35	66.32	72.33	65.73
T3	80.53	66.11	73.54	89.40	85.04	76.86	82.31	85.36	85.51	88.24
T7	55.99	76.36	66.00	89.72	83.63	66.31	73.92	63.49	77.67	75.38
T8	63.19	53.52	75.37	82.84	68.00	68.05	74.10	63.81	64.33	74.26
T9	31.16	53.14	53.00	49.40	58.57	68.44	51.68	70.09	48.73	54.69

Analysis of variance for percentage of filled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	3955.05	5	791.01	8.74**	3.38
Within Groups	4888.41	54	90.53		
Total	8843.46	59			

** significant at 1% level

8.10 Percentage of unfilled grain

Treatment	r1	r2	r3	r4	r5	r6	r7	r8	r9	r10
T1	44.31	42.48	27.13	23.42	38.10	10.45	42.42	46.83	11.46	34.25
T2	28.76	22.16	31.17	37.55	35.83	24.71	30.65	33.68	27.67	34.27
T3	19.47	33.89	26.46	10.60	14.96	23.14	17.69	14.64	14.49	11.76
T7	44.01	23.64	34.00	10.28	16.37	33.69	26.08	36.51	22.33	24.62
T8	36.81	46.48	24.63	17.16	32.00	31.95	25.90	36.19	35.67	25.74
T9	68.84	46.86	47.00	50.60	41.43	31.56	48.32	29.91	51.27	45.31

Analysis of variance for percentage of unfilled grain of KDML 105

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	3955.05	5	791.01	8.74**	3.38
Within Groups	4888.41	54	90.53		
Total	8843.46	59			

** significant at 1% level

Appendix D

Table 1 Effects of CS and DS application on major elements in straw of SPR 1 in Pot Experiment I

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca(ppmw)	Mg (ppmw)
C1	1.255±0.016	2565.19±25.51	3900.00±60.00	5937.61±73.39	3811.50±102.30	296.40±10.00
C2	0.806±0.004	2549.37±33.29	4860.00±300.00	4625.69±27.52	3521.10±53.90	558.80±8.40
CS3	1.550±0.004	1938.61±72.60	4500.00±300.00	5001.83±36.70	3472.70±190.30	269.20±11.60
CS5	1.448±0.012	1476.58±129.95	4500.00±60.00	5084.40±45.87	4045.80±81.40	253.60±1.60
CS9	1.618±0.007	1736.08±60.35	5520.00±240.00	5185.32±0.00	4200.90±67.10	322.80±0.40
DS3	1.557±0.007	2989.24±67.85	4200.00±0.00	6442.20±9.17	3669.60±90.20	311.60±6.00
DS5	1.536±0.004	2429.11±52.95	4560.00±120.00	5680.73±36.70	4106.30±223.30	303.20±17.60
DS9	1.848±0.013	2005.06±51.81	6060.00±180.00	5625.69±110.09	3688.30±20.90	334.40±1.60

Table 2 Effects of CS and DS application on minor elements in straw of SPR 1 in Pot Experiment I

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
C1	13.30±0.10	1363.00±19.00	96.10±0.30	375.70±11.90
C2	11.80±0.20	711.30±6.90	370.00±6.00	299.50±18.50
CS3	11.20±0.20	783.70±37.30	58.30±0.30	311.80±16.60
CS5	12.20±0.00	794.60±43.20	66.70±3.10	333.30±6.50
CS9	12.70±0.10	1134.60±73.40	62.30±1.30	313.20±18.00
DS3	13.40±0.00	1138.00±12.00	72.90±0.30	267.70±11.30
DS5	12.30±0.30	1079.50±10.50	60.20±1.00	228.10±11.10
DS9	12.30±0.10	846.70±7.30	108.80±1.00	270.60±4.00

Table 3 Effects of CS and DS application on major elements in straw of KDML 105 in Pot Experiment I

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca(ppmw)	Mg (ppmw)
C1	1.574±0.005	1650.63±19.68	5820.00±180.00	5240.37±18.35	4055.70±223.30	490.80±18.00
C2	0.775±0.006	3188.61±73.99	9660.00±180.00	5836.70±82.57	3478.20±88.00	661.20±9.20
CS3	1.902±0.015	2410.13±54.08	7200.00±360.00	5552.29±128.44	3229.60±74.80	441.20±10.00
CS5	1.853±0.010	1812.03±94.50	8220.00±60.00	4258.72±45.87	3570.60±39.60	465.60±7.20
CS9	1.683±0.040	1789.87±98.66	9420.00±180.00	6084.40±110.09	3714.70±128.70	520.00±14.40
DS3	1.932±0.008	1887.97±99.45	9060.00±180.00	5148.62±18.35	3256.00±94.60	470.00±7.60
DS5	1.739±0.008	2451.27±32.01	6120.00±0.00	6066.06±18.35	3704.80±74.80	460.80±12.00
DS9	2.705±0.005	2590.51±68.44	6480.00±120.00	6368.81±45.87	3232.90±38.50	374.00±3.60

Table 4 Effects of CS and DS application on minor elements in straw of KDML 105 in Pot Experiment I

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
C1	14.30±0.10	743.10±8.70	192.60±0.20	124.60±9.60
C2	13.80±0.20	593.70±29.10	280.50±1.90	101.90±9.70
CS3	12.50±0.10	781.10±9.30	163.50±3.30	80.80±0.20
CS5	12.50±0.10	407.90±17.70	315.50±0.50	89.00±0.20
CS9	13.70±0.10	444.80±32.80	431.00±1.80	115.60±2.60
DS3	13.40±0.20	785.90±12.50	96.70±1.30	87.60±3.40
DS5	14.10±0.10	762.40±23.80	112.70±1.10	99.70±2.30
DS9	14.10±0.30	1119.00±25.00	129.90±0.10	105.10±0.70

Table 5 Effects of CS and DS application on major elements in seed of SPR 1 in Pot Experiment I

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
C1	1.715±0.005	2774.05±83.71	2150.50±122.10	1809.17±18.35	451.20±33.60	599.20±29.60
C2	1.622±0.010	3185.44±77.75	3078.90±75.90	1699.08±36.70	556.80±8.80	1178.00±31.60
CS3	1.912±0.002	1169.62±49.70	2101.00±13.20	2304.59±18.35	514.40±13.60	501.20±0.40
CS5	2.086±0.018	1008.23±61.44	2436.50±23.10	2258.72±9.17	648.00±26.40	615.20±26.40
CS9	2.078±0.016	1337.34±44.57	2436.50±7.70	2313.76±45.87	568.80±1.60	728.80±8.00
DS3	1.903±0.017	1432.28±63.37	2101.00±59.40	2240.37±27.52	431.60±10.00	646.40±7.20
DS5	1.984±0.017	1274.05±64.83	2244.00±46.20	2313.76±9.17	451.20±13.60	553.20±19.60
DS9	1.888±0.036	1340.51±39.36	2003.10±40.70	2469.72±18.35	395.20±10.40	481.20±18.00

Table 6 Effects of CS and DS application on minor elements in seed of SPR 1 in Pot Experiment I

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
C1	9.90±0.50	142.10±0.30	21.80±0.20	40.70±0.50
C2	13.50±0.10	72.90±5.10	67.30±1.90	40.10±0.90
CS3	11.10±0.10	88.50±0.50	19.70±0.30	38.30±0.30
CS5	12.80±0.20	83.60±0.20	21.80±0.60	36.80±1.60
CS9	11.40±0.20	83.40±4.60	26.60±0.20	38.70±0.10
DS3	9.10±0.30	88.00±12.00	16.70±0.10	34.20±0.20
DS5	9.70±0.70	97.90±9.10	20.80±1.00	35.20±0.80
DS9	13.60±0.80	96.10±4.50	23.90±0.70	41.00±0.40

Table 7 Effects of CS and DS application on major elements in seed of KDML 105 in Pot Experiment I

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
C1	1.568±0.028	2406.96±135.68	2194.50±34.10	1763.30±9.17	346.00±13.20	767.60±30.80
C2	1.648±0.018	2925.95±88.21	2371.60±134.20	1735.78±0.00	416.80±44.00	886.80±89.20
CS3	2.255±0.031	2853.16±75.51	1931.60±30.80	1891.74±27.52	334.00±12.40	746.00±10.00
CS5	2.335±0.010	2720.25±55.42	1783.10±82.50	1845.87±18.35	490.80±38.80	676.40±5.20
CS9	2.335±0.002	2495.57±31.59	1917.30±3.30	2176.15±55.05	398.80±10.80	710.40±13.60
DS3	2.095±0.038	2296.20±12.12	2153.80±116.60	2111.93±82.57	374.80±22.00	783.20±67.20
DS5	1.851±0.021	2622.15±34.42	1621.40±92.40	1882.57±18.35	423.60±30.80	473.60±35.20
DS9	2.482±0.044	2932.28±75.13	2101.00±41.80	1937.61±18.35	481.20±17.20	755.60±4.40

Table 8 Effects of CS and DS application on minor elements in seed of KDML 105 in Pot Experiment I

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
C1	20.40±0.60	86.60±5.80	19.80±0.80	37.80±0.80
C2	23.10±1.30	74.40±11.80	28.60±4.40	41.40±3.00
CS3	18.80±0.20	99.00±10.80	16.60±0.00	40.60±1.80
CS5	10.80±0.00	70.00±2.40	17.80±0.20	40.50±0.70
CS9	9.80±0.20	70.20±0.60	21.50±0.30	44.30±0.10
DS3	10.10±0.50	86.80±13.20	27.20±1.60	42.20±1.20
DS5	9.20±0.60	64.30±0.90	16.30±1.50	34.80±1.20
DS9	7.30±0.10	119.30±2.50	18.20±0.00	42.30±0.30

Table 9 Effects of CS and DS application on elements in soil of SPR 1 in Pot Experiment I

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
Before	0.124±0.002	296.31±2.82	2.04±0.01	117.03±0.16	20.72±0.23	1.38+0.05
C1	0.173±0.001	149.94±2.22	3.24±0.21	91.17±11.95	25.88±1.13	6.59±0.22
C2	0.181±0.003	243.11±1.11	3.38±0.00	129.30±0.23	28.43±0.01	4.04±0.15
CS1	0.171±0.001	-	-	-	-	-
CS3	0.177±0.001	177.31±1.07	5.47±0.08	325.00±17.1	29.37±0.29	18.88±0.46
CS5	0.182±0.001	192.68±1.34	5.14±0.53	365.94±24.6	30.13±0.52	13.24±0.87
CS7	0.193±0.000	-	-	-	-	-
CS9	0.195±0.002	224.05±5.33	5.34±0.57	377.34±5.47	29.80±2.60	13.05±1.66
DS1	0.190±0.003	-	-	-	-	-
DS3	0.177±0.001	188.38±1.92	4.63±0.04	311.72±17.9	28.37±0.21	8.61±0.06
DS5	0.183±0.001	150.55±1.07	4.87±0.45	333.13±20.6	30.10±0.98	15.13±1.03
DS7	0.191±0.000	-	-	-	-	-
DS9	0.190±0.002	156.09±2.44	5.45±0.73	385.16±5.47	33.34±0.95	13.80±1.36

Table 10 Effects of CS and DS application on elements in soil of KDML 105 in Pot Experiment I

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
C1	0.143±0.005	213.59±3.42	3.64±0.28	217.92±5.63	27.48±3.40	3.93±0.17
C2	0.138±0.006	330.75±3.93	2.88±0.21	152.97±15.1	30.54±0.70	4.09±0.05
CS1	0.128±0.002	-	-	-	-	-
CS3	0.161±0.007	217.90±4.02	4.75±0.14	258.96±34.7	30.48±1.75	7.10±0.02
CS5	0.142±0.003	211.44±0.53	4.04±0.01	183.67±2.58	32.12±0.13	4.41±0.11
CS7	0.144±0.002	-	-	-	-	-
CS9	0.143±0.002	291.70±0.92	4.34±0.09	195.42±4.17	33.28±0.81	4.27±0.11
DS1	0.138±0.003	-	-	-	-	-
DS3	0.140±0.003	226.81±8.08	4.14±0.16	217.32±22.5	19.79±1.85	6.70±0.14
DS5	0.148±0.001	202.52±4.31	4.68±0.07	253.91±10.1	29.60±0.73	7.70±0.28
DS7	0.145±0.002	-	-	-	-	-
DS9	0.145±0.009	194.83±1.92	5.17±0.06	293.75±1.56	33.95±0.55	6.21±0.02

Table 11 Effects of CS in combination with chemical fertilizer on major elements in straw of SPR 1 in Pot Experiment II

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	0.488±0.000	1742.41±94.64	15240.00±240.00	4708.26±128.44	4948.90±62.70	412.00±27.97
T2	0.419±0.010	2280.38±53.80	15360.00±0.00	4781.65±91.74	4413.20±206.80	494.00±44.71
T3	1.582±0.005	1606.33±42.30	8820.00±180.00	6056.88±192.66	6903.60±11.00	386.80±58.30
T4	1.260±0.008	3337.34±134.30	-	11139.45±192.66	-	-
T5	0.617±0.013	1919.62±127.04	18840.00±360.00	5093.58±91.74	5287.70±166.10	540.80±42.55
T6	0.462±0.005	1416.46±87.85	-	3928.44±27.52	-	-

Table 12 Effects of CS in combination with chemical fertilizer on minor elements in straw of SPR 1 in Pot Experiment II

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	7.70±0.30	408.80±38.00	191.90±4.90	171.20±24.00
T2	8.00±0.00	421.00±37.20	261.70±3.30	236.30±23.90
T3	8.00±0.00	537.90±0.70	139.00±4.20	143.60±6.20
T4	-	-	-	-
T5	10.30±0.10	213.80±2.80	110.10±0.50	128.70±9.70
T6	-	-	-	-

Table 13 Effects of CS in combination with chemical fertilizer on major elements in straw of KDML 105 in Pot Experiment II

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca(ppmw)	Mg (ppmw)
T1	0.620±0.006	2666.46±42.42	18120.00±120.00	6139.45±0.00	4219.60±367.40	509.20±10.80
T2	0.428±0.005	2489.24±53.80	14700±60.00	4625.69±9.17	4538.60±66.00	699.20±8.00
T3	2.615±0.009	1834.18±55.42	14580.00±660.00	6717.43±9.17	3614.60±338.80	387.20±40.00
T4	1.392±0.013	1481.01±127.89	-	6836.70±18.35	-	-
T5	0.589±0.003	1069.62±36.54	16020.00±300.00	4148.62±12.97	4823.50±64.90	698.00±0.40
T6	0.468±0.003	1085.44±47.47	-	3405.50±0.00	-	-

Table 14 Effects of CS in combination with chemical fertilizer on minor elements in straw of KDML 105 in Pot Experiment II

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	7.00±0.00	246.80±9.80	292.20±5.40	326.00±22.00
T2	6.80±0.20	214.00±3.00	585.40±0.20	387.00±1.40
T3	7.30±0.10	1276.00±84.00	198.90±8.70	140.20±14.80
T4	-	-	-	-
T5	5.90±0.50	284.00±6.60	161.20±2.60	213.40±15.60
T6	-	-	-	-

Table 15 Effects of CS in combination with chemical fertilizer on major element in seed of SPR 1 in Pot Experiment II

Treatment	N(g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	1.146±0.015	2185.44±18.90	2696.10±93.50	2075.23±45.87	374.00±29.20	731.60±47.60
T2	0.873±0.007	2232.91±16.75	3162.50±91.30	2332.11±9.17	372.80±2.40	935.60±17.20
T3	1.676±0.046	2033.54±18.90	2750.00±13.20	2212.84±36.70	472.00±16.80	475.60±14.80
T4	1.709±0.020	2020.89±74.95	-	2020.18±45.87	-	-
T5	1.212±0.006	2011.39±58.92	2456.30±71.50	1726.61±27.52	369.20+2.80	568.40±20.40
T6	1.047±0.004	2242.41±28.95	-	1845.87±18.35	-	-

Table 16 Effects of CS in combination with chemical fertilizer on minor element in seed of SPR 1 in Pot Experiment II

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	27.30±0.30	144.50±1.10	47.50±2.10	32.50±0.10
T2	29.90±0.30	94.60±1.60	49.90±0.10	43.90±0.90
T3	26.30±0.50	80.20±1.80	23.90±0.70	35.60±2.80
T4	-	-	-	-
T5	26.00±0.20	59.60±1.40	26.20±0.80	30.60±0.60
T6	-	-	-	-

Table 17 Effects of CS in combination with chemical fertilizer on major elements in seed of KDML 105 in Pot Experiment II

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	1.300±0.014	1150.63±23.68	2008.60±46.20	1937.61±55.05	210.80±2.00	776.00±20.80
T2	1.031±0.012	1163.29±33.89	2321.00±37.40	1836.70±9.17	208.40±23.60	844.40±20.40
T3	2.071±0.029	1096.84±16.65	1955.80±46.20	1983.49±27.52	278.40±28.80	441.20±18.00
T4	1.986±0.014	1068.35±126.42	-	2066.06±0.00	-	-
T5	1.334±0.014	1486.08±31.22	1910.70±7.70	2304.59±91.74	279.60±30.00	595.20±16.00
T6	1.118±0.043	1770.89±41.02	-	2194.50±110.09	-	-

Table 18 Effects of CS in combination with chemical fertilizer on minor elements in seed of KDML 105 in Pot Experiment II

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	26.00±0.40	95.10±1.10	31.00±0.00	55.30±0.70
T2	26.50±0.30	62.50±0.90	26.60±0.00	48.40±1.20
T3	22.90±0.70	69.50±1.90	22.70±0.50	42.70±0.30
T4	-	-	-	-
T5	25.20±0.00	65.80±1.40	20.00±0.60	53.30±0.90
T6	-	-	-	-

Table 19 Effects of CS in combination with chemical fertilizer on elements in soil of SPR 1 in Pot Experiment II

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
Before	0.129±0.001	256.03±1.71	2.47±0.17	92.88±9.63	22.60±0.46	1.83±0.18
T1	0.145±0.006	231.73±5.08	3.84±0.25	226.80±28.2	36.58±1.21	1.79±0.10
T2	0.132±0.002	320.91±3.93	2.79±0.21	266.95±26.8	31.72±1.33	1.06±0.16
T3	0.136±0.001	276.94±6.54	1.92±0.08	311.09±6.09	13.05+0.50	0.87±0.17
T4	0.135±0.001	357.50±2.15	-	-	-	-
T5	0.132±0.001	275.40±3.93	2.98±0.25	257.50±19.0	29.20+1.90	0.99±0.12
T6	0.125±0.001	345.51±12.6	-	-	-	-

Table 20 Effects of CS in combination with chemical fertilizer on elements in soil of KDML 105 in Pot Experiment II

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
Before	0.129±0.001	256.03±1.71	2.47±0.17	92.88±9.63	22.60±0.46	1.83±0.18
T1	0.134±0.001	212.36±4.88	2.38±0.02	94.69±0.94	24.80±0.16	1.09±0.01
T2	0.130±0.001	273.25±5.76	1.25±0.00	115.86±0.23	13.23±0.02	0.58±0.02
T3	0.140±0.001	245.26±1.63	1.57±0.01	127.81±0.47	16.13±0.04	0.79±0.15
T4	0.134±0.003	289.85±4.55	-	-	-	-
T5	0.145±0.006	244.34±1.63	2.77±0.01	148.83±10.7	29.07±0.70	1.22±0.05
T6	0.139±0.003	335.67±9.53	-	-	-	-

Table 21 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in straw of SPR 1 in Pot Experiment III

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	0.488±0.000	1742.41±94.64	15240.00±240.00	4708.26±128.44	4948.90±62.70	412.00±27.97
T2	0.419±0.010	2280.38±53.80	15360.00±0.00	4781.65±91.74	4413.20±206.80	494.00±44.71
T3	1.582±0.005	1606.33±42.30	8820.00±180.00	6056.88±192.66	6903.60±11.00	386.80±58.30
T7	1.671±0.030	1549.37±26.60	-	5735.78±73.39	-	-
T8	1.452±0.017	3340.51±31.43	-	10625.69±9.17	-	-
T9	1.016±0.020	2590.51±69.02	14760.00±600.00	9634.86±137.61	6859.60±156.20	430.40±8.00

Table 22 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on minor elements in straw of SPR 1 in Experiment III

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	7.70±0.30	408.80±38.00	191.90±4.90	171.20±24.00
T2	8.00±0.00	421.00±37.20	261.70±3.30	236.30±23.90
T3	8.00±0.00	537.90±0.70	139.00±4.20	143.60±6.20
T7	-	-	-	-
T8	-	-	-	-
T9	9.90±0.10	299.80±2.00	181.20±1.60	194.20±21.60

Table 23 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in straw of KDML 105 in Pot Experiment III

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca(ppmw)	Mg (ppmw)
T1	0.620±0.006	2666.46±42.42	18120.00±120.00	6139.45±0.00	4219.60±367.40	509.20±10.80
T2	0.428±0.005	2489.24±53.80	14700±60.00	4625.69±9.17	4538.60±66.00	699.20±8.00
T3	2.615±0.009	1834.18±55.42	14580.00±660.00	6717.43±9.17	3614.60±338.80	387.20±40.00
T7	2.156±0.003	4322.78±255.13	-	6543.12±18.35	-	-
T8	1.699±0.023	5367.09±189.87	-	5616.51±27.52	-	-
T9	1.349±0.010	8278.48±560.17	14580.00±60.00	8579.82±275.23	4413.20±255.20	610.80±17.20

Table 24 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on minor elements in straw of KDML 105 in Pot Experiment III

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	7.00±0.00	246.80±9.80	292.20±5.40	326.00±22.00
T2	6.80±0.20	214.00±3.00	585.40±0.20	387.00±1.40
T3	7.30±0.10	1276.00±84.00	198.90±8.70	140.20±14.80
T7	-	-	-	-
T8	-	-	-	-
T9	6.40±0.40	308.90±7.70	101.40±2.20	152.90±9.70

Table 25 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in seed of SPR 1 in Pot Experiment III

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	1.146±0.015	2185.44±18.90	2696.10±93.50	2075.23±45.87	374.00±29.20	731.60±47.60
T2	0.873±0.007	2232.91±16.75	3162.50±91.30	2332.11±9.17	372.80±2.40	935.60±17.20
T3	1.676±0.046	2033.54±18.90	2750.00±13.20	2212.84±36.70	472.00±16.80	475.60±14.80
T7	1.881±0.023	1963.92±44.87	-	2139.45±18.35	-	-
T8	1.788±0.010	2343.67±25.51	-	2011.01±36.70	-	-
T9	1.643±0.016	2150.63±69.52	2620.20±11.00	1965.14±9.17	458.80±3.60	470.00±1.20

Table 26 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on minor elements in seed of SPR 1 in Pot Experiment III

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	27.30±0.30	144.50±1.10	47.50±2.10	32.50±0.10
T2	29.90±0.30	94.60±1.60	49.90±0.10	43.90±0.90
T3	26.30±0.50	80.20±1.80	23.90±0.70	35.60±2.80
T7	-	-	-	-
T8	-	-	-	-
T9	25.60±0.20	61.30±1.70	30.20±0.00	31.00±0.40

Table 27 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in seed of KDML 105 in Pot Experiment III

Treatment	N (g%)	P (ppmw)	K (ppmw)	S (ppmw)	Ca (ppmw)	Mg (ppmw)
T1	1.300±0.014	1150.63±23.68	2008.60±46.20	1937.61±55.05	210.80±2.00	776.00±20.80
T2	1.031±0.012	1163.29±33.89	2321.00±37.40	1836.70±9.17	208.40±23.60	844.40±20.40
T3	2.071±0.029	1096.84±16.65	1955.80±46.20	1983.49±27.52	278.40±28.80	441.20±18.00
T7	2.113±0.048	1884.81±31.43	-	1790.83±18.35	-	-
T8	1.814±0.044	2134.81±22.75	-	2194.50±18.35	-	-
T9	1.819±0.017	2118.99±15.07	1948.10±29.70	1946.79±27.52	298.80±14.00	552.40±14.80

Table 28 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on minor elements in seed of KDML 105 in Pot Experiment III

Treatment	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
T1	26.00±0.40	95.10±1.10	31.00±0.00	55.30±0.70
T2	26.50±0.30	62.50±0.90	26.60±0.00	48.40±1.20
T3	22.90±0.70	69.50±1.90	22.70±0.50	42.70±0.30
T7	-	-	-	-
T8	-	-	-	-
T9	24.00±0.00	59.10±1.90	20.90±0.70	46.70±0.10

Table 29 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in soil of SPR 1 in Pot Experiment III

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
Before	0.129±0.001	256.03±1.71	2.47±0.17	92.88±9.63	22.6±0.46	1.83±0.18
T1	0.145±0.006	256.03±1.71	3.84±0.25	226.80±28.2	36.58±1.21	1.79±0.10
T2	0.132±0.002	231.73±5.08	2.79±0.21	266.95±26.8	31.72±1.33	1.06±0.16
T3	0.136±0.001	320.91±3.93	1.92±0.08	311.09±6.09	13.05±0.50	0.87±0.17
T7	0.141±0.004	266.48±3.25	-	-	-	-
T8	0.140±0.002	306.15±3.55	-	-	-	-
T9	0.134±0.002	416.85±1.63	2.57±0.13	296.72±7.97	18.65±1.82	0.74±0.05

Table 30 Effects of fixed amount of latex serum (100S), and variable chemical fertilizer on major elements in soil of KDML 105 in Pot Experiment III

Treatment	N (g%)	S (ppmw)	Cu (ppmw)	Fe (ppmw)	Mn (ppmw)	Zn (ppmw)
Before	0.129±0.001	256.03±1.71	2.47±0.17	92.88±9.63	22.6±0.46	1.83±0.18
T1	0.134±0.001	212.36±4.88	2.38±0.02	94.69±0.94	24.80±0.16	1.09±0.01
T2	0.130±0.001	273.25±5.76	1.25±0.00	115.86±0.23	13.23±0.02	0.58±0.02
T3	0.140±0.001	245.26±1.63	1.57±0.01	127.81±0.47	16.13±0.04	0.79±0.15
T7	0.137±0.001	342.44±1.60	-	-	-	-
T8	0.133±0.000	275.09±2.97	-	-	-	-
T9	0.132±0.003	246.80±4.27	2.61±0.05	144.69±0.94	27.41±0.65	0.66±0.05

Biography

Miss Krongkaew Sakornrat was born on January 29, 1974 in Chonburi province. She got Bachelor degree in Biology from Silpakorn University in 1995. After that she worked for S V I Elastomer company as Marketing and Administrator for 4 years. At the same time, she joined the course in Bachelor degree in Occupational Health and Safety, Faculty of Public Health, Sukhothai Thammathirat Open University. In 1999, she joined the course in master degree in Biotechnology, Program in Biotechnology, Faculty of Science, Chulalongkorn University.