Topic 9 – data-based questions

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1. the rate of water uptake decreases from $17 \text{ cm}^3 \text{ hr}^{-1}$ to $0$;
2. cutting the top of the shoot resulted in a decrease from $10 \text{ cm}^3 \text{ hr}^{-1}$ to $4 \text{ cm}^3 \text{ hr}^{-1}$;
3. $10 \text{ cm}^3 \text{ hr}^{-1}$ to $-5 \text{ cm}^3 \text{ hr}^{-1}$ to $= 5 \text{ cm}^3 \text{ hr}^{-1}$;
4. the pressure generated in the xylem by the leaves on the shoot resulted in a greater uptake of water than that of the vacuum ($18 \text{ cm}^3 \text{ hr}^{-1}$ vs $5 \text{ cm}^3 \text{ hr}^{-1}$);

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1. a) addition of the fungus has an effect on both shoot dry mass and root dry mass, but a greater effect is observed on shoot dry mass; different species have different effects; *paxilliis* has the greatest effect; *pisolithus* has least effect;
   b) increases surface area of roots; allowing greater mineral absorption and greater water absorption; promoting plant growth;
2. a) as root dry mass increases, shoot dry mass also increases – the relationship is direct;
   b) more roots can support greater shoot mass;
   c) the two species of *Laccaria* and the two species of *Theelophora* all have a significant effect. Conclusion is supported by *Theelophora* less so by *Laccaria*;

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assume labels: A C
B D
1. C has more negative solute potential which will draw water
2. water is under positive pressure because of solute having drawn the water there; forced downward due to positive pressure;
3. as solute is withdrawn, pressure difference causes water to move down from C to D
4. pressure potential differences lead water to move from D to B;

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1. a) (i) active transport of sugar
   (ii) create high solute concentration; water drawn in by osmosis;
   b) (i) no oligosaccharides at sucrose concentration below $0.25 \text{ mol dm}^{-3}$; oligosaccharides concentration rises between $0.25$ and $0.50 \text{ mol dm}^{-3}$; no further increase above $0.50 \text{ mol dm}^{-3}$;
   (ii) to reduce water loss from aphid/gut cells by osmosis;
   c) (i) poor source of amino acids, with many (especially essential amino acids) at a lower percentage in phloem sap that aphid proteins;
   (ii) plants synthesize amino acids for making plant proteins; plant and aphid proteins have different amino acid composition;
   d) (i) feed aphids on phloem sap containing antibiotics; test aphid growth rates/protein synthesis rates/amino acid contents;
   (ii) physiological problems have to be overcome; problem of phloem sap dehydrating cells by osmosis; problem of lack of essential amino acids;
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a) direct relationship; as photosynthesis rate climbs, translocation climbs;

b) (i) the higher the light intensity, the greater the translocation rate;
   (ii) greater light intensity should lead to greater rates of photosynthesis which will lead to more sugar production which would lead to greater rates of translocation so it is a cause and effect relationship;

c) 5: 245 = 0.02;
   3: 131 = 0.02;

d) it is a growing leaf as net photosynthesis rate is far in excess of what is being translocated; sugar must be used for storage in leaf or leaf development;

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(i) leaves 1 and 6;

(ii) on the same side as the source leaf; above the source leaf; youngest leaves (though this is less relevant to location);

(iii) drawing is not clear so difficult to conclude; 4 and 3 appear to be lateral rather than above or below; pruning causes re-routing: hypothesis unsupported; photosynthate appears in leaves on the opposite side after pruning;

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a) IAA causes a lowering of pH, with large initial changes; the pH then stabilizes; IAA could trigger proton pumping;

b) at about 50 minutes;

c) once pH reaches its lowest level, the maximum increase in length occurs;

d) the rate of elongation is greater in pH 3 than in pH 7; elongation stops at pH 7, but not at pH 3;

e) IAA promotes elongation again at neutral pH;

f) addition of KCN prevents elongation;

g) hypothesis supported; figure 5 shows that IAA lowers pH; figure 6 shows that IAA promotes elongation even with neutral pH; figure 7 shows that IAA has no effect with the addition of proton pump blocker;

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1. for all planting dates there is an initial low rate of increase in the number of nodes; a linear increase in the number of nodes; all groups produce nodes at the same rate/slope of lines are approximately equal; all plants stop producing new nodes at the same time; the earliest plantings produce the greatest number of nodes;

2. a) approximately 20 August;

   b) day length is a key factor; day (light) length grows shorter in late August; critical day length reached/soybeans are short day plants;

3. a) earlier planting yields more nodes; by flowering time more fruits produced per plant;

   b) possible frost risk; possible drought risk; early flowering if day length is critical length early in season;

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1. the diameter of the pollen grain is likely to be the cause of both the mean growth of the pollen tube and the optimal sucrose concentration; these can be represented on a single graph or on two different graphs;
2. as the diameter of the pollen grain increases, mean growth of the pollen tube decreases, though this is a weak correlation; as the diameter increases, the optimal sucrose concentration decreases; this is a reasonably strong correlation; one possible explanation for a certain concentration of sucrose triggering germination may be that this concentration matches the concentration on the stigma of the species;

3. the experiment could have been improved by increasing the number of trials;

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1. 0.5 µm;

2. the dye appears only on the outside of the cuticle; it was able to penetrate through the testa but was not able to reach through to the embryo;

3. a) in the control seed, the stain is only on the surface of the cuticle; in the smoke treated seed, the stain has penetrated further (nearly to the embryo);
   b) fire damages/melts cuticle; allowing water to penetrate and promote germination; in the absence of fire seeds do not germinate because of the cuticle;

4. in climax ecosystem the plant can’t compete – *Emmenannthe* is a colonizer species; after fire, more nutrients and more light are available.
**Topic 9 – end of topic questions**

1. a) as temperature increases, permeance also increases; at higher temperatures, rate of increase of permeance increases; Liriodendron shows this relationship in particular;
   
   b) increases in permeance means more water loss; the plant will need an alternative strategy for preserving water;
   
   c) (i) 1.3 µm;
   
   (ii) 1.7 µm;
   
   d) data is highly variable and the highest permeance values are at lower thickness; data does not support the hypothesis;

2. a) 2.9 (± 0.2) mm
   
   b) cyclic light makes style grow almost immediately while with continuous light it takes longer to start to grow; (L16 / D8) starts growing in first hour while L24 style starts growing after 6 hours; growth is more gradual in L24; with continuous light the style grows less; continuous (L24) grows to 9.8 mm while cyclic (L16 / D8) grows to 10.2 mm / little difference after 28 hours; in both cases growth only starts with anthesis;
   
   c) 47% / more fertilized ovules in cyclic light; filament grows more in cyclic light than continuous; pollen closer to stigma, so pollination more probable; in continuous light anthers do not become exposed;
   
   d) standard deviation is a measure of variability, indicating the spread of values around the mean; continuous light data is more variable (because it has a higher standard deviation); helps to decide whether the difference between two means is significant; 68% of values are 1 SD from mean; difference between means is approximately 47, appears to be significantly different; light treatment makes a significant difference;
   
   e) darkness promotes and white light inhibits because filaments shorter than in darkness; red light inhibits because filaments shorter than in darkness; auxins promote because filaments are longer than in control / in white and red light; gibberellic acid inhibits because filaments are shorter in continuous white light / darkness;
   
   f) self-pollination reduces / does not promote variation / no new combination of alleles; no variation for natural selection; more susceptible to infectious diseases; more prone to genetic disease / (inbreeding) more likely to be homozygous for disease;

3. a) (i) 2 mM kg⁻¹
   
   (ii) 180 %
   
   b) cells in stem absorb water (by osmosis) providing turgidity / turgor pressure
   
   c) maintain osmotic balance; help to maintain turgidity; assist active transport;
   
   d) active transport means movement against a concentration gradient; there is no concentration gradient / concentration in xylem should be lower than stem (but it is not);
   
   e) diffusion / facilitated diffusion.